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MODERN CONVENIENCES FOR THE FARM HOME.

BY

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PREPARED UNDER THE SUPERVISION OF THE OFFICE OF EXPERIMENT STATIONS.
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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., September 19, 1906.

SIR: I have the honor to transmit herewith, and to recommend for publication as a Farmers' Bulletin of this Department, an article on Modern Conveniences for the Farm Home, by Elmina T. Wilson, C. E., formerly assistant professor of civil engineering, Iowa State College.

Respectfully,

A. C. TRUE,
Director.

Hon. JAMES WILSON,
Secretary of Agriculture.

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MODERN CONVENIENCES FOR THE FARM HOME.

The failure to employ modern methods of lightening labor inside the house is a great hardship on many farms. Thoughtfully planned, conveniently arranged, and carefully constructed buildings are as essential in the country as in the city. Plumbing is becoming a necessity, not only for comfort and convenience but even more for health and cleanliness; and the proper disposal of the wastes of the household should not be neglected.

THE WATER SUPPLY.

For domestic purposes the water must be clear, pure, and palatable; the essentials being freedom from disease germs, turbidity, color, odor, and taste.

Springs and wells.—Of the various sources of supply springs usually rank first and deep wells next in desirability. The character of the water in a shallow well depends upon its past history and present environment. If it has traveled long distances thru the soil without encountering organic impurities or taking up objectionable mineral salts, or if after possible pollution it has been filtered and purified in its travels, its quality is probably excellent. But shallow wells near barnyards or privy vaults should always be regarded with suspicion. It is well to remember that the price of pure water, wherever you go, is everlasting and unremitting vigilance.

The danger of using the ordinary shallow well is known to everyone. To locate a cesspool and a well on the same small piece of ground is almost impossible without contaminating the water. Slop water of any kind should never be thrown near the well. The top 4 or 5 feet of the well casing should be laid up in cement mortar to prevent water flowing in without first filtering thru the ground. A sewer pipe or waste drain near a well is dangerous because such a pipe or drain is seldom water-tight. If a sewer pipe must be run near a well, cast-iron pipe should be used.

The carelessness that will locate the barn on higher ground than the well and take no precautions to divert the surface drainage is almost as deplorable as the use of the cesspool or privy vault. To keep the earth clean in the vicinity of the water supply is of the greatest importance and requires constant watchfulness.

WATER STORAGE.

Cisterns.

There are localities where the only available water supply is obtained by storing the water which falls from the roof of the house during rainy weather. In other places the water is so hard that rain water is desirable in the laundry and bathroom.

Construction.—The size of the cistern needed will vary with the size of the family, the length of the dry season, and the number of plumbing fixtures supplied with the rain water. This cistern may be located close to the house for convenience and should be built of good, hard brick, with walls not less than 8 inches in thickness, laid in Portland cement mortar. The bottom should be laid with two courses of brick well bedded in the cement mortar. If the water is to be used for drinking or for cooking, a filter chamber should be added by building an 8-inch partition wall after the bottom has been paved. This wall should be built a little higher than the outlet of the overflow pipe. The walls of both compartments should be plastered with a good coat of cement mortar, composed of one part good Portland cement and two parts clean, sharp sand, excepting 10 or 12 inches of the bottom of the partition wall (4 or 5 courses of brick, which are laid together without cement) for the water to pass thru. The water from the roof is collected in one compartment and is pumped from the other, the filtering material being put in the first compartment. An overflow pipe should be provided on the side of the cistern which the water enters, the opening of the overflow pipe being fitted with a fine strainer to exclude insects or vermin. A cut-off should be placed on the rain-water pipe leading to the cistern to divert the flow to the outside when necessary, as, for instance, for a short time at the beginning of the rains to exclude the dirt collected on the roof and in the gutters.

The cistern may be built of concrete, and may be either round or rectangular. The round form is the more difficult to build, but it is the stronger. A description of the method of building a rectangular concrete tank is given under "Disposal of sewage" (p. 27).

Use of a pump.—A small force pump, placed at one end of the kitchen sink, with the suction pipe reaching to the cistern, is a convenient means of getting the soft-water supply if the more expensive method of using a gravity tank or a pneumatic tank and piping the soft water to the sink, wash basins, and bath tub is not desired. If a gravity soft-water tank is placed in the attic it can have a direct connection with a rain-water leader which will keep the tank full during the rainy season. This connection must be supplied with an automatic cut-off which will send the water to the cistern when the attic tank is full. The force pump can be connected to the tank and used to fill it in dry seasons.

To have a constant water supply in the kitchen and bathroom it is necessary to have some means of storing it under pressure. An elevated tank which will deliver the water by gravity may be used, or a pneumatic tank which will deliver it by air pressure. The labor saved by having the water carried to the house, barn, and garden will soon pay for the storage tank, while the value of adequate fire protection and the healthfulness of sanitary plumbing can not be estimated in dollars.

Elevated Tanks.

Location of the tank.—If the gravity system is chosen, the tank for the storage of the water may be in the attic or on an outside tower. If a windmill is used for power, a small tank can be supported 20 to 40 feet from the ground, on the same tower. These tanks can be constructed of wood or of galvanized steel, and of capacity varying from 300 to 2,000 gallons. If a larger tank is desired, a tank on an independent tower should generally be used with pipe connections to house and barns. When the storage for the house supply is in the attic, too large a tank should not be used, as water is heavy (62.5 pounds per cubic foot) and there is danger of overloading the attic floor unless it has been especially designed to carry the tank.

Kinds, construction, and cost.—Attic tanks are constructed of wood lined with zinc or lead, of galvanized steel, of cast iron, and of wrought iron. Such tanks should always be provided with an overflow pipe to carry off the water if the float valve fails to shut it off when the tank is full. If of iron or steel, a galvanized steel tank pan with a drain connecting with the overflow pipe should be placed beneath the tank to prevent damage to floors and ceilings from condensation of moisture on the outside. The water supply is regulated by means of a float valve which cuts off the inlet pipe when the tank is full enough. The size of the tank will be regulated by the power used to raise the water as well as the amount required by the family. The hydraulic ram or the windmill will require only a small storage tank, as they are so easily set going. If an engine is used, a tank that will hold a two or three days' supply would be more convenient and economical. A closed steel tank, fitted with a water-seal air valve, may be used in the attic with the overflow pipe leading to the stock tank in the barnyard. This insures a constant renewal of the water. There is one farm in Illinois where the water supply is forced to an attic tank and the fall of the surplus operates a water motor for lifting the cistern water to another tank in the attic, and then the surplus water goes to a tank in the haymow of the barn with an overflow pipe to a stock tank in the barnyard. This illustrates how well the head can be made to save the heels.

If all the plumbing fixtures are on the ground floor, the closed steel tank for the cold-water supply can be placed in the kitchen or bathroom. If desired, the entire water supply can be made to pass thru this house tank and so the house supply will be always fresh. With a closed tank there is no danger from overflow.

A tank like this, 12 inches in diameter and 4 feet high, will hold 24 gallons and cost about $16. An open galvanized steel tank can be made or can be bought ready-made. A ready-made one with a capacity of 100 gallons will cost about $8, while a 500-gallon tank will cost about $16.

Pneumatic Tanks.

Sufficient pressure to force a water supply wherever desired in a farmhouse may be secured at all seasons by means of a pneumatic tank built of steel plates and located in the cellar, or in a small building erected over the well, or even buried in the earth if desired. It is superior to an elevated tank because the pipes and tank can more easily be made frost proof in winter and the water will be cooler in summer. It is closed to dust and light and has the additional advantage of resting upon the solid ground.

Principle of action.—Water is pumped into the bottom of this air-tight tank, and as the water rises in the tank the air above it is comprest. The expansion of this comprest air will force the water thru the supply pipes at the bottom of the tank to points where the water is required. The pressure is increased by pumping more water into the tank and decreased by drawing water off. A 15-pound pressure will raise water to a height of 33 feet, a 10-pound pressure to a height of 22 feet, etc. The correct amount of air can be supplied and maintained by an automatic air valve, by a pump that forces both air and water into the tank at the same time, or by a hand air valve. The last method is not self-regulating, but if water is supplied to the tank by a hand force pump, it will not require much more attention to regulate the air pressure also.

Power; cost.—The water can be forced into the pneumatic tank by the same means required to elevate it to a gravity tank, i. e., by a windmill, gas engine, hot-air engine, hydraulic ram, or by hand. From ten to twenty minutes a day with a good hand force pump will furnish a moderate supply. If more than 100 gallons a day are required, it is better to use some other means of pumping. If an engine is used, a large tank is more economical, and twenty minutes' pumping twice a week should furnish the supply. With a windmill an automatic regulator should be used, which will throw the windmill out of gear when the pressure reaches a given amount and start it again when the pressure is relieved.

The prices vary with the different manufacturers. A tank 30 inches in diameter and 10 feet long, which would supply the needs of a family of five, is listed at from $101 to $138 (subject to discount). The expense for repairs to an outfit like this is very slight and the time required for pumping varies with the power used.

Neighbors can frequently combine and put in one large plant for supplying water to several houses. This decreases the cost to the individual and gives a greater pressure in case of fire. The greater the horizontal distance the water is carried the larger the pipes should be to lessen the loss of pressure by friction.

POWER AVAILABLE.

What will be the most convenient and economical means of forcing water into the storage tank depends upon the situation in each case. The source of the supply, the amount required, the need of power for other purposes, the available fuel, and the cost of labor will all have a bearing on the matter. The hydraulic ram and the windmill have the advantage of operation without fuel, but the ram requires at least 18 inches of waterfall, while with the windmill the daily supply of water is not always subject to control. The gas or hot-air engine requires fuel and attendance, but the supply is more easily regulated.

The Hydraulic Ram.

The hydraulic ram (fig. 1) can be used to fill the storage tanks if the source of supply is a spring, flowing well, or running stream from which enough fall to supply the power can be obtained. Its use is practicable with a fall of only 18 inches, but with greater heads water can be forced to higher elevations and to longer distances. The head can be increased by damming the stream or by sinking the ram into a pit, if a drain can be secured to keep the pit free from water. The

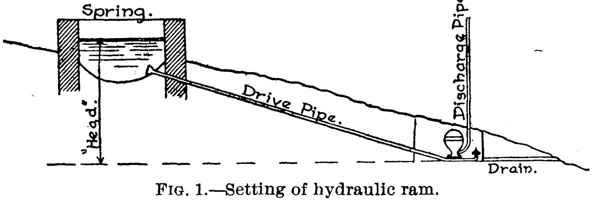

FIG. 1.—Setting of hydraulic ram.

relation between the height of the spring, or source of supply, above the ram and the elevation to which the water is to be delivered determines the proportion of water raised to water wasted. It is not economy to increase the fall more than is necessary to supply the required amount of water, as the durability of the ram will be lessened. The amount of water procured by means of a ram from a very small fall makes a good supply because the ram is always going.

It is not necessary that the water which is pumped should be the same as the power water. Pure water can be delivered by the use of impure water without danger of mixing by means of a compound ram.

The size of the ram to be used will depend upon the amount of water power and both the amount of water required and height to which it is raised. The water can be delivered into an elevated tank or a pneumatic tank as desired and the overflow can be utilized by a water motor for pumping cistern water, shelling corn, or in any of the other numerous ways of saving hand labor.

The length of the drive pipe depends upon the fall to the ram and the height to which water is delivered. The delivery pipe will be governed by the conditions usual to water pipes. After the pipes are laid it is well to leave them uncovered until they are given a test in order to discover any leaks. The attention required by a ram is very little. A visit of inspection twice a week may be necessary. The mechanism is simple and, as the wearing is only in the two valves, the expense of maintenance is small. A small ram can be installed for $50 or less (pipe not included), and will be found a useful means of furnishing a water supply in many cases.

Windmills.

A good and simple way of securing a supply of water is by the use of a windmill. When the machine is properly constructed it will pump large quantities of water, and, like the ram, without cost, as the wind is free and the cost of repairs is very small. The tower should lift the wheel 10 or 15 feet higher than the tallest obstruction. The galvanized steel tower has almost entirely taken the place of the wooden tower, and is proving very durable. A combination tower which carries both a windmill and a storage tank is furnished by some manufacturing companies under the name of "suburban outfit." This outfit gives ample pressure for ordinary requirements, and can be made frost proof by inclosing the exposed pipes in two or more wooden casings with air spaces between, the outer casing being of matched boards and painted. A combination pumping and power mill is also manufactured, at a small additional cost, which will pump the water, grind the feed, shell the corn, saw the wood, and do the washing and churning with no expense for fuel; but the wind must blow.

If the windmill supplies a tank in the attic the supply is regulated by a tank float which shuts off the supply pipe when the water reaches a certain height and admits water again when the water level of the tank is lowered. An expansion joint should be used on the supply pipe to prevent the overstraining of the joints due to change of temperature. The same pipe that delivers water to the tank may be used to supply the house fixtures. If the windmill supplies a pneumatic

tank an automatic pump should be used which will throw the wheel out of gear when a certain pressure is reached, and, when water is drawn, the reduction of the pressure will throw it in gear again.

The cost of installing a windmill will depend upon the depth and character of the well and its distance from the house and barns, upon the height of the tower, upon the elevation or pressure of the storage tank, and upon the amount of water required each day. These items vary so much with the individual cases that it is unsatisfactory to attempt to give even general figures. Any manufacturer of windmills will furnish an estimate upon application.

Gas or Hot-Air Engines.

Small gas or hot-air engines are now manufactured for the express purpose of pumping water from cisterns, springs, or wells to elevated or pneumatic tanks to furnish supplies for houses and barns. One advantage of the engine over the hydraulic ram or the windmill is that the water can be pumped when it is wanted, and the size of the storage tank can be more accurately determined. An engine can be selected which will burn any kind of fuel—natural gas, gasoline, kerosene, coal, or wood. Such engines do not require an expert to run them, and, like the power windmill, can be used for driving other light machinery when not needed for pumping water.

The arrangement of the pipes to carry the water is governed by the same conditions as when other power is used. No more elbows or sharp bends should be used than are absolutely necessary, as they cut down the capacity of the engine; and when the water is to be pumped thru a great length of horizontal pipe it is well to increase the size of the pipe.

The cost of a two or three horsepower engine will be from $60 to $130. The cost of the fuel is very small, as a half hour's pumping a day will furnish the average supply of water.

THE HOUSE

LOCATION.

In selecting a location for a house there are certain points that should be held in mind. A slight elevation, having proper surface drainage, with protecting hills or woods on the north, is greatly preferable to a narrow valley, a low meadow, or the north side of a hill. The house should face so as to get sunlight into all the rooms, if possible, for "where sunlight does not enter the doctor must." This may be accomplished by facing the house southeast, for example, instead of directly east or south.

FOUNDATION AND CELLAR.

After the selection of the site some study should be given to the character of the subsoil, the principal factors to be considered in this connection being the water and the air. There is a certain amount of moisture in the upper layer of the soil which is the cause of damp and unhealthy foundations. This dampness is derived mostly from the surface water, and is directly proportional to the absorptive power of the soil and can be diminished by tiling and trenching. The ground air is rendered impure by the gases arising from the decomposition and putrefaction that are constantly going on in the soil, especially in that which is contaminated by household wastes.

In the construction of the cellar the first thing is to provide such drainage as will draw off the water at least 1 foot lower than the surface of the cellar floor and prevent the ground air from passing thru the walls and floors. In building the cellar walls every joint should be entirely filled with mortar. A good coat of asphalt over the outside of the wall turned in at the grade line with a course of slate or bluestone above ground level will prevent all soaking up of moisture. If a draintile is laid just outside the footing course and the space on the outside of the wall is filled with sand and gravel all the way up to grade, the surface water will be carried away thru the drain.

The floor of the cellar is best made by a layer of brick or of cinder concrete, covered by a layer of asphalt and finished by a 4-inch layer of stone concrete. A layer of well-beaten clay makes a good cellar floor, but it can not be so easily kept clean. The height of the cellar walls above the ground is important. They should extend a sufficient distance above the ground to admit of windows in the cellar at least 2 feet high. This will insure plenty of light and thoro ventilation. There should be cellar windows on all sides of the house.

PLUMBING.

IMPORTANT POINTS TO BE KEPT IN MIND.

There is a great difference of opinion among those who have made special study of sanitary plumbing concerning many of the details of construction and design, but the vital things to be kept in mind when laying out the system are to use the best material, isolate all plumbing, and concentrate as much as possible. By "best material" is not meant the most expensive, but the most durable. Secure simplicity in all needed fixtures. Avoid complications in waste pipes. Select sinks without grease traps, bath tubs without inaccessible overflows, wash basins free as possible from fouling places, and water-closets without valves, connecting rods, or machinery.

The drainage system must be so constructed as to carry away completely, automatically, and immediately everything that may be delivered into it. It should be constantly and generally vented, frequently and thoroly flushed, and have each of its openings into the house securely guarded from the entrance of air from the interior of the drain or pipe into the room. All drains, soil pipe, and waste pipe should be absolutely tight against the leakage of water or air.

The main line of the house drainage system begins at the sewer, flush tank, or septic tank, as the case may be, passes thru the house by such a course as may be indicated by a judicious compromise between directness and convenience, past the location of the highest fixture that is to discharge into it, and then out thru the roof for free ventilation. If possible, have the fixtures which are located on different floors in a direct line one above the other to avoid any considerable horizontal run. If bathrooms or water-closets are required in different parts of the house let each have its own vertical line of soil pipe. All plumbing fixtures on bedroom floors should be confined to bathrooms, and under no circumstances should there be a wash basin or any other opening into any channel which is connected with the drainage system in a sleeping room or in a closet opening into a sleeping room. Each bathroom should have exterior location and at least one window for light and ventilation, but pipes should not be placed against outer walls unless adequately protected against frost. Never have plumbing out of sight; let each pipe be in full view, and each closet, bath, or basin be unhidden by any sort of inclosing woodwork. There is quite as much danger from the dirt which is apt to gather around concealed pipes and beneath inclosed sinks, bowls, or closets as there is from the admission of sewer gas. The simplest way to prevent the accumulation of dirt is to make it easier to be clean than to be dirty. Therefore keep the plumbing fixtures where there is plenty of light.

IMPROVEMENTS FOR THE KITCHEN.

The kitchen is a most important part of the house. On it depends the physical life, and to a large degree the spiritual life, of the family. Realizing its importance, sufficient time and thought should be given to it to secure the best results possible from the material at hand.

Ventilation; walls and floors.—Perfect ventilation is the first requirement of a kitchen, light comes next, and in turn the possibilities of perfect cleanliness. The walls should be painted so that they may be wiped off with a damp cloth, making cleanliness possible without great demand on strength, and without the disarrangement caused by whitewashing and kalsomining. In these days of enameled paint the walls and shelves of all kitchen closets should be painted. Painted shelves

can be wiped off with a damp cloth every day if need be. Paper in kitchen closets is always a bid for dust and vermin.

Hard wood makes the best kitchen floors. Linoleum or oilcloth are labor-saving and, if cut to exactly fit the floor and all joints cemented, are perfectly sanitary. Intelligence does not countenance a carpet on the kitchen floor.

The range.—Whatever fuel is used, let the range be one of the best in the market. This is true economy. Near the range and under the same ventilating hood should stand the oil or gasoline stove. There is an infinite variety of these stoves, all economical, cleanly, and safe if managed with care.

A hood suspended over the kitchen range and connected to a flue in the chimney will gather all the steam and odors and carry them away.

Laundry arrangements.—When the kitchen is also used as the family laundry, stationary tubs of enameled iron or of soapstone should adjoin the sink. They should be covered to form a table when not in use, but as confined air near plumbing becomes dangerous the covers should close upon rubber knobs or wooden blocks, so as to leave an air space for ventilation. Nickle-plated union strips and hardwood-ringer holders should be added between the tubs and at the right-hand end so that a wringer may be used. One of the needs of the ordinary farmhouse is a suitable place for the workmen to wash as they come from the fields. When a separate room is fitted up as a laundry, provision should be made here for the men by adding a large sink and bench.

The kitchen sink.—The kitchen sink should be of cast iron, plain, galvanized or enameled, broad, and of a generous size, preferably with a high back to protect the wall from the water which is certain to splash when drawn rapidly from the pipes. The faucets should be set well up and back to avoid the breakage of dishes by striking them against the faucets. The waste pipe should be covered with a fairly fine brass strainer, which should be held securely in place by screws. At one end should be placed a long draining shelf, the shelf should be well grooved and inclined slightly toward the sink. Both tubs and sink should be well trapt, but as grease traps when neglected are filthy things, and as proper care of the pipes renders them unnecessary in an ordinary kitchen, they should be avoided. Kitchen and pantry sink drains should be treated frequently to a wash of hot water and ammonia or soda to keep them clear from deposits of grease. Kitchen sinks are used for the discharge of liquids which in their original condition are not offensive, but which after a little retention begin to putrefy, and it is very important to secure the complete removal of all such matter well beyond the limits of the house before putrefaction begins.

Refrigerator drains should never connect directly with the drainage system.

Hot-water apparatus.—A hot-water supply may be furnished by a special heating apparatus in the cellar, a furnace connection, or, as is usual in small houses, by a boiler and water-front attachment for the range. In figure 2 is shown the boiler, water front, and pipes for a successful water heating and circulating system. The cold water should always enter the boiler at some distance below the point of entrance of the hot water from the water front of the range; the greater this distance the better will be the circulation, and the less time it will take to heat a certain amount of water. The kitchen boiler is simply a storage tank to keep a supply of hot water on hand so that it can be drawn when required. The chemical properties of the water often determine whether a copper or galvanized-iron boiler may be used. Certain waters will rust out a galvanized-iron boiler in a few years, while a copper boiler, used in its place, would last a lifetime. The hot water stores itself in the upper part of the boiler and is forced out by the cold water entering at the bottom. The upper pipe, or

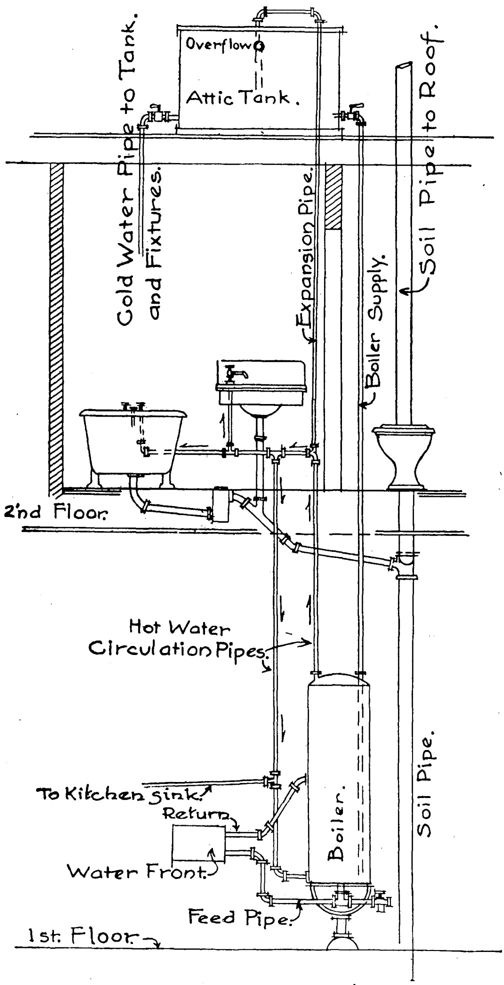

FIG. 2.—Hot-water circulation.

hot-water pipe, from the water front to the boiler must not be allowed to sag but must have as much elevation as possible, and also large-sized elbows should be used, in order that the flow of water will have the least possible friction to contend with. The more elevation we get from the water front to the boiler the better the water will circulate, but the slightest rise in the pipe will make a satisfactory job. It should be a continuous rise from the range to the boiler. To prevent

the pounding of steam in the boiler an expansion pipe should be provided to allow the escape of steam and air bubbles if the water comes from a tank in the attic. This expansion pipe should open over the overflow from the attic tank. When pressure tanks are used the expansion pipe must be omitted. The sediment which is constantly accumulating in the boiler should be blown off thru the stopcock for that purpose, found under every boiler.

The range and boiler are set as close together as they can be for the purpose of getting the best results in regard to the heating of the water. The best kind of pipe for connecting them is either copper or brass, ¾ or 1 inch in diameter, with fittings of the same material having threaded joints. Lead pipe is too soft for the purpose and will not stand the high temperatures which the water in these connections often reaches. If it is desired to draw hot water from the different faucets thruout the house at the moment the faucet is opened instead of having to wait until all the water in the pipe has been drawn out, it is necessary to have a circulation of the hot water at all times from the boiler to the different fixtures. The hot-water pipe is started from the boiler and carried up, as shown in figure 2, to the highest fixture and then connected. The return pipe is carried down, as shown by the direction of the arrows, and this pipe connects with each of the lower fixtures, finally ending at the bottom connection of the boiler. Be sure to have some upward slope at all points to the pipe which leads from the boiler to the highest fixture; but it is not necessary that the return have a continuous fall.

INSTALLATION OF THE BATHROOM.

Walls and floors.—The bathroom should be a light, well-ventilated room with every facility for cleanliness. Floors and wainscoting of tile or composite material are most desirable, but painted walls are much less expensive and give excellent results. Tile is undoubtedly the most satisfactory material which can be used for the covering of the floors and walls where it can be afforded. Tile floor with covered base and walls finished with cement or hard plaster, painted with enamel paint, are much cheaper. When a tile floor can not be had, linoleum is an excellent substitute as it is practically impervious to water. It should be laid before the fixtures are set, in order that there may be no joints. Cement mixt with small chips of marble well rubbed down after setting makes an excellent floor, one that washes as clean as a porcelain plate and has no cracks to harbor dirt; the cost is only about twice that of a double wood floor, or 50 cents per square foot, including the necessary cement bed on which it is laid. When it is desired to lay a cement, composition, or tile floor upon wooden floor joists, proceed as follows: Nail a 2 by 4 to the side

of each of the floor joists flush with the bottom. Upon the top of these stretch wire lath, after the joists have first been covered with tarred paper to prevent them absorbing moisture; and upon this lay cinder concrete, made of 1 part Portland cement, 3 parts loose sand, 6 to 8 parts crusht and screened furnace clinkers; filling in to a level at least 2 inches above the tops of the joists. Upon this is placed the floor finishing. Cinder concrete is used because it is so much lighter than that made of stone. When a tile or cement wainscot is too expensive the walls should be painted. Wall paper is not desirable in a bathroom, nor is wood paneling.

Bath tub and lavatory.—A porcelain-lined or enameled-iron bath tub is the best medium-priced tub. For supplying the tub with water a combination cock is best, allowing hot or cold water to enter the tub separately or the temperature to be regulated to suit the bather. The cocks should be placed high, so as to allow of water being drawn into pitchers.

The best lavatories are those of porcelain or enameled iron, with back and overflow all formed as integral parts of the fixture. The basin cocks thru which the hot and cold water come are of various shapes, the simplest being the best.

The closet.—The water-closet is the most important plumbing fixture in the house, and should be selected and put up with particular care. A good closet should be simple, neat, and strong, of a smooth material, with ample water in the bowl. Among the modern closets there is none more satisfactory than the flushing-rim, siphon-jet closet, which can be had, including the trap, in a single piece of porcelain. Porcelain is used because no other material can be kept so clean and sanitary. But even this is an imperfect protection from dirt and disease unless the bowl is flushed so as to clean it completely and absolutely. The water should be poured from the rim of the bowl, so that every part of it is perfectly cleaned. The wash-down and wash-out closets are similar in make, but are not so thoro in their action. In the wash-out closet the basin acts as a receiver, a small quantity of water being retained in it, and into this the deposit is made, to be washt out afterwards into the trap by the flush. The water in the basin is prevented from leaking into the trap by a raised ridge which is apt to break the force of the flush so that its whole force is not directed into the trap, which is objectionable. The wash-down closet receives the deposit directly into the water held in the bowl by the trap. It has a straight back and a much smaller fouling surface. There is no open vent. The outlet is entirely covered with water, so that the water does not throw the soil against the side. The only advantage the siphon closet has over it is the greater force of discharge given by the siphon.

The siphon closet, like the wash-down closet, retains a certain

amount of water into which filth is discharged. In addition there is a siphon trap provided with a long ascending arm, so that the water in the trap is at a lower level than the water in the bowl. The water from the flushing cistern is directed not only into the bowl, but downward into the trap itself. As a result of this discharge into the trap a siphon action is produced whereby the contents of the bowl are sucked thru the trap into the soil pipe without soiling the bowl. The seal—that is, the body of water which prevents the sewer gas from escaping into the house—is deep, broad, and always in plain sight.

Flushing apparatus.—The flushing cistern or tank for a water-closet is always distinct from the main water supply. As a rule, a plain hardwood box, copper-lined, is supported by brackets from the wall about 7 feet above and communicating with the closet by a pipe. This pipe is usually about 1½ inches in diameter and should have as few bends and angles about it as possible. The cistern should hold 2 or 3 gallons of water, all of which should be discharged at one time into the closet. The flush of the closet should be quick, powerful, and noiseless, thoroly scouring all parts exposed to fouling.

The flow into the cistern is regulated by a float valve which allows the tank to fill, the float rising with the water; when it reaches the proper level the float is entirely raised and the supply shut off. When the tank is emptied by opening the flush valve, which is lifted by pulling a chain attached to it, the process is repeated. The cistern is usually provided with an overflow connected with the flush pipe, so that if the ball-cock fails to act properly in shutting off the water the surplus will escape thru the water-closet to the drain instead of overflowing.

Soil-pipe connections.—The best closets are provided with a brass screw soil-pipe connection, calked with lead and cemented into the base of the closet. The corresponding threaded brass coupling is soldered into the end of the lead bend which connects with the soil pipe. The closet is then screwed into the threaded coupling until the base rests on the floor. The closet may be removed at any time by simply unscrewing it. No bolts are necessary thru the base flanges. In setting a water-closet a neater finish can be obtained if a porcelain floor slab is put in with the finished floor.

General suggestions.—The important need of the work is simplicity, not only in detail, but in general scheme. Construct the water-closet to be used as a urinal and slop sink and arrange to draw water thru the bath cocks placed at the top of the tub. It not only saves cost, but is a great advantage to have the fewest possible points requiring inspection and care and to secure the most frequent possible use of every inlet into the drainage system. Great care must be taken not to throw into the water-closet hair, matches, strips of cloth, or any-

thing which is insoluble and liable to clog the trap and soil pipe. A burnt match seems small in itself, but if lodged in the trap it will collect other things and cause serious obstruction of the outlet. Tissue toilet paper should be used. Its cost would be exceeded many times if a part of the system needed to be taken out to free it from newspaper obstruction. It is often found more convenient to have the water-closet with a separate entrance from the hall and entirely independent from the bathroom.

TRAPS AND VENTS.

Every plumbing fixture must have a trap to prevent the foul air from coming back from the drain thru the waste pipe. In its simplest form a trap is a downward bend in a pipe, so deep that the upper wall of the pipe dips into the water held in the bend, the extent to which it dips being known as the depth of the seal. With slight modifications this is the trap most commonly used for wash basins, laundry tubs, etc. Its greatest fault is the danger from siphonage; that is, the water seal may be carried out of the trap into the soil pipe by the rush of the water when the fitting itself is emptied, by the flow of water from another fixture on the same branch waste pipe, or by the discharge of water from a fixture higher up but connected to the same soil pipe. This danger is much lessened by the introduction of a system of ventilation pipes extending upward either from the trap itself or from the outlet near the trap. To avoid this extra expense of a third system of pipes, it is better to supply each fixture with one of the patent nonsiphonage traps, which should also be self-cleansing. There are several good ones on the market. It is a good habit, after emptying the wash basin, bath tub, or kitchen sink, to allow some clean water from the faucet to run into the fixture in order to have clean water in the traps. All traps should be provided with trap screws, placed below the water line, and arranged so as to be accessible for cleaning.

Nothing short of continuous use will prevent the evaporation of the water in the traps. One with a large dip is best, but at the same time the trap must be so formed that at each use of the fixture all the filth that is delivered shall be carried away, the trap being immediately refilled with fresh water. Hair and fibers from cloth sometimes carry the water out of traps by capillary attraction, and care should be taken not to allow such things to enter the pipes.

THE SOIL PIPE.

The soil pipe should extend from cellar to roof in a straight line, if possible, as each offset or bend forms an obstruction to its proper flushing with both water and air. Use only "extra heavy" soil pipe of uniform thickness thruout, as the hubs stand the calking better.

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Avoid if possible plumbing fixtures in the cellar if the drain must go under the floor. If it is necessary to make connections with a fixture in the cellar it is better that the main channel should run under the floor to or near the location of such fixtures that all or nearly all of its length should constitute a part of the main drain thoroly flushed and ventilated like the rest of the system. The pipe should be laid in an open trench and so thoroly calked that under a pressure equal to one story in height not a drop of water should escape at any point, and then it should be inclosed in good concrete, after which the trench should be filled. The soil pipe should pass thru the foundation by means of an arch, and the cast-iron pipe should extend at least 5 feet outside the foundation; from there on, a carefully laid and rigidly inspected vitrified pipe drain is to be preferred. The joint between the iron pipe and the vitrified sewer pipe should be made with neat Portland cement mortar. If there are no fixtures in the cellar carry the drain in full sight along the face of the cellar wall, or suspended from the floor beams, so the joints may be inspected. At the point where it is to turn up as a vertical soil pipe support it by a post or a brick pier. Use no short turns in the soil pipe, like "tees" and "quarter bends." Two one-eighth bends or a Y branch and a single one-eighth bend give a more gradual and therefore a better change of direction. Water-closets should connect to the soil pipe with a Y branch. The soil pipe should be secured along its entire length at distances not over 5 feet with hangers and clamps or hooks, so that it will be rigidly held in position. The joints in the cast-iron soil pipe should be made by first inserting a little picked oakum into the socket, allowing none to enter the pipe; it is better formed into a sort of rope. The oakum prevents the lead from running into the pipe to form an obstruction to the flow. Enough molten lead is then poured into the hub to fill it. After the lead has cooled it is carefully hammered with a special calking tool until the space between the spigot and hub is perfectly gas and water tight. Every joint should be made with a view to being tested with hydraulic pressure.

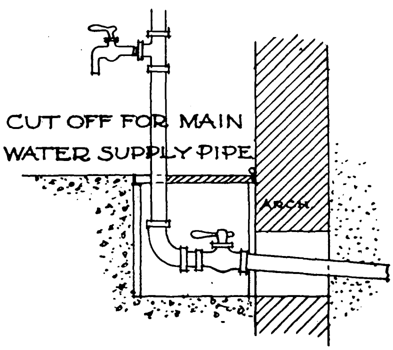


FIG. 3.—Cut-off for main water-supply pipe.

In making this test the simplest way is to close all openings into the pipe with wooden plugs or disks of India rubber comprest between two plates of iron forced together with a screw. There is no especial advantage in applying a great head of water, for if a joint is not tight it will leak under a head of a few inches. It is generally most con-

venient to test the vertical pipe story by story, the plugs being inserted thru the water-closet branches. There is probably no occasion to fear that work once made tight will develop leaks for many years. The tendency to rust after a time, even with tar-coated or enameled pipe, being rather to close such slight leaks as may exist.

Four inches in diameter is sufficient for soil pipe, and the best results are obtained by running it full size straight above the roof and covering the top with a wire basket such as is used to keep leaves out of gutters.

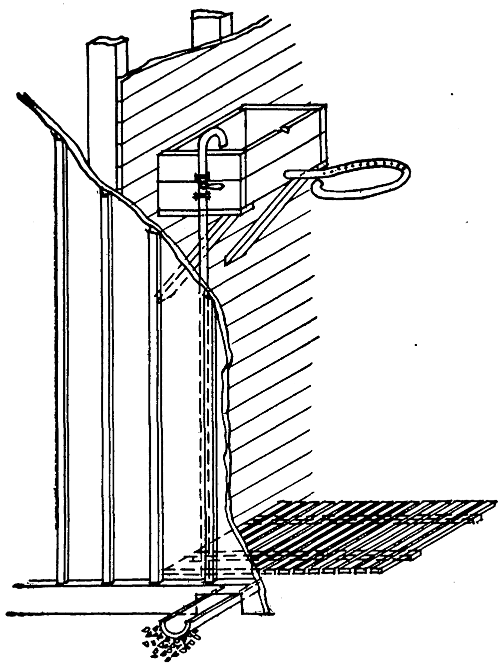


FIG. 4.—Homemade shower bath.

There should always be a trap between the house and the sewage-disposal plant, and there must also be on the house side of it an inlet for fresh air. There can be no real ventilation of the system if it is open only at the top, but a generous inlet for fresh air on the drain outside the house, in connection with the opening at the top of the soil pipe, will insure a free movement thruout the whole system. The fresh-air inlet must be guarded from obstruction. It may be brought out close to the foundation walls, but not too near windows and doors. If the trap is formed by the submerging of the inlet pipe in the settling chamber of the disposal system the fresh-air inlet should be placed close to this.

THE WASTE PIPES.

For all minor waste pipes lead pipe is used, as it may be bent and cut to suit all possible positions and requires but few joints. Only "heavy" lead pipe should be used. As lead is quite a soft material it would not be practicable to use thread joints on it, so the joints are made by the use of solder. Where lead pipe joins to cast-iron pipe the connection should be made by means of a brass ferrule of the same bore as the lead pipe, and soldered to it. The ferrule is introduced into the hub of the cast-iron pipe and calked tight with oakum and lead as described for cast-iron pipe joints.

WATER-SUPPLY PIPES.

The service pipe of the water supply should always have a stopcock on the main supply pipe easy of access so the water can be shut off quickly in case of a break in the pipe. Such a cut-off is shown in figure 3. This stopcock should have a waste, so that when the water is shut off from the house all water standing in the pipe can be drawn off. The arrangement of the supply pipes should be as compact as possible, and they should be exposed to full view. No water pipe should be carried along an outside wall unless absolutely necessary, when it should be wrapt with some nonconducting material to prevent freezing. Hot-water pipes will freeze quicker than cold-water pipes if the fire has gone out.

It is better in most cases to use galvanized-iron supply pipes.

A HOMEMADE SHOWER BATH.

A shower bath for summer use can be arranged in one corner of the wash room or, for use of the boys, in the barn. The material necessary for constructing it are enough pipe to connect to the main pipe of the stock tank, a stopcock, a box supported on brackets and lined or not as seems best, and a perforated pipe for the shower. Figure 4 shows how such a shower bath may be constructed in a corner of a barn.

DISPOSAL OF WASTE WATER.

In houses where a sewage system is not available, and the dry-earth closet is used, much may still be done to aid the housewife by the introduction of water for kitchen and laundry use. Instead of porta-

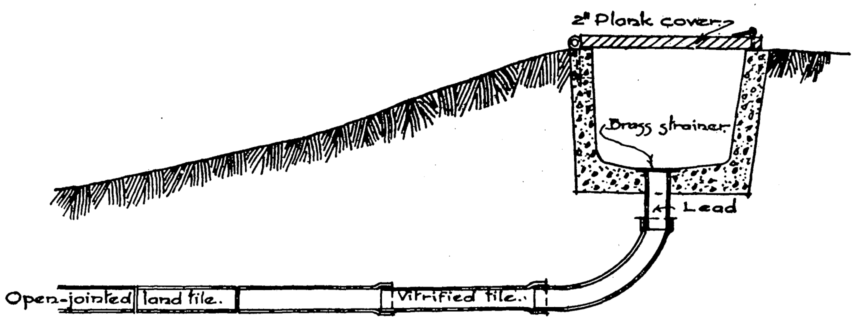


FIG. 5.—Waste-water hopper.

ble round tubs, oblong troughs about 3 feet in length, 18 inches wide at the top, 12 inches at the bottom, and 18 inches deep can be built in the washhouse. Each trough should have a hole and stopper in the bottom and a gutter common to all to carry away the waste water, which, with the waste water from the bath and kitchen sink, chamber

slops, and other foul water, can be daily distributed in the garden by surface or subsurface irrigation. Either method is much preferable to pouring them on the ground near the kitchen door and keeping the ground about the house continually saturated.

For surface distribution, galvanized roof gutters pierced with holes at regular intervals, suspended between the rows of growing plants, will distribute the liquid evenly over the ground. For subsurface distribution, 50 feet of 3-inch draintile laid with open joints and a very slight fall in one or several lines at a depth of 8 to 10 inches below the surface and connected with a hopper, as shown in figure 5 can be used. This hopper can be made of wood or galvanized iron, and is provided with a strainer and solid cover. That part of the pipe which is more than 10 inches below the surface should be of vitrified pipe and laid with cemented joints. The waste water when poured into such a hopper a pailful at a time will be distributed the length of the tile.

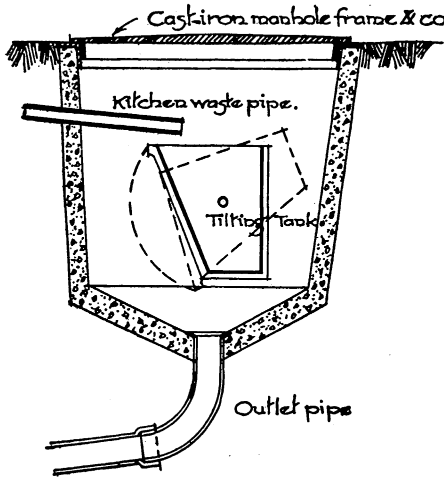


FIG. 6.—Tilting tank.

For a more elaborate system a tilting or tumbling tank (fig. 6) can be built with pipe connections to the kitchen sink and bathroom, this tank to collect the irregular flow and empty, when full, into the drain.

EARTH CLOSETS.

Where there is difficulty in the matter of ultimate disposal without the use of a cesspool, and the consequent and apparently unavoidable risk thereby incurred of contaminating the well water, it would be better to use an earth closet. This is not wholly satisfactory, but is safer and far better than the provision so often found on farms and in villages. The house containing it should be well built and substantial, well lighted and ventilated, with a good roof, and preferably plastered on the inside to insure less exposure in cold weather. A carefully made and dry walk, screened by lattice for protection from the wind and for privacy, should be built to it. The excreta should be received in a galvanized-iron pail, not too large and made to fit close under the seat. This seat can be like that of an ordinary water-closet. Each time the closet is used dry earth is added. The pail should be emptied very frequently. With proper attention this closet need not

be, and should not be, built far from the house. It would even be possible to place it in a room built against the house, the room having one door opening from the house and another opening out of doors. This would make it possible to enter from the house in inclement weather, and also to carry out the pail without passing thru the house. The room should be well ventilated by a window close to the ceiling, and only tissue paper should be used. (See fig. 7 for arrangement of pail, seat, and dry-earth box.)

The earth for use in these places is to be found in nearly every field and garden and should be of rather a loamy nature if possible, and porous. A very sandy soil is next to useless. Large heaps of earth should be collected for the year's use and dried in the summer sun. It is not necessary to use perfectly dry earth, but it is always the best.

DISPOSAL OF SEWAGE.

After the plumbing has been put into the house, to make it effective, a means must be provided to remove all liquid wastes as soon as possible and to prevent the return of odors.

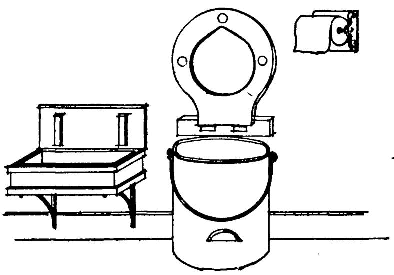


FIG. 7.—Earth closet.

Dangers of a cesspool.—As has been previously explained, to build a cesspool to foul the ground and air is not a solution; it is only putting the trouble "out of sight." It holds the wastes in a state of putrefaction, and so will give off troublesome gases, which will, if near the house, penetrate to the cellar and then on thru the house. Its liquid leachings, if these strike a layer of sand and gravel or a fissure in the rock, will penetrate an unthought-of distance to injure the quality of water of wells and springs. Such a system would never be installed if the householder realized the full effect of the nuisance he was establishing. Fortunately it is no longer necessary to build a cesspool when plumbing is introduced into the house which can not be connected to a public sewer.

Principle of modern sewage disposal.—Within the last twenty years many investigations of sanitary methods for the disposal of sewage for isolated houses have been made. The working principle is this: When the air contained in the soil is brought in contact with dead organic matter in a finely divided state, a complete transformation takes place by the natural processes of oxidation and nitrification. This change is brought about by micro-organisms which multiply rapidly under proper conditions and by so doing combine the oxygen

of the air with the organic matter. Air is as necessary for this purpose as fuel in a stove that is required to give off heat. It is therefore essential that the waste be deposited on or near the surface of the ground and in such a way that air reaches every particle. If the ground is saturated for a long period of time purification of the liquid will cease. If a foul liquid is thrown on the surface of the ground the water will pass off, but its organic impurities will cling to the particles of earth. Air takes the place of the water and surrounds the waste matter, the bacteria present in all fertile soils effect a combination between the two, converting the dead organic matter to harmless mineral forms needed for vegetable life. This process may be repeated indefinitely if the waste matter be supplied and the air furnished alternately. This is called the "intermittent method" of operating the disposal plant. The process of applying this principle to the disposal of sewage varies, and may be divided into two distinct steps: (1) The collection of the wastes from the house that these may be applied intermittently; and (2) their application to a natural soil by surface or subsurface irrigation, or to a specially prepared soil, as in a filter bed.

Three systems described.—The ground available on one farm can not be, and need not be, exactly the same as that used on another. If the surface is almost level and under cultivation the subsurface system of distribution could be adopted, whatever the method used for collecting the flow from the house. The liquids are retained for a certain length of time and then rapidly discharged into open-jointed tiles, laid near the surface, thus securing a uniform distribution thruout the entire length of the drain. While the tank is refilling time enough is allowed for the water to pass away and the air to enter and accomplish its work. This manner of purifying the liquid wastes of the household where the water-closet is or is not used has been tried with entire satisfaction.

Another method of getting the liquid wastes on the land is by surface irrigation. The most marked feature of the change from the privy to the water carriage system is the great dilution which the organic matter undergoes. Instead of concentrated organic wastes, unsuited for direct use as a fertilizer, we now have a dilute mixture which seldom contains more than 1 part in 500 of anything but water. Of course this can not be discharged in a haphazard manner upon the land, but if the intermittent method, as explained above, be followed and the discharge be regulated to avoid saturation of the ground, the sewage can be disposed of without unsightly or offensive results. The area of the ground required is about the same as for subsurface disposal. A sloping surface in grass, or partially wooded, or a cultivated field, say of corn, would be entirely suitable. The area required depends upon the character of the soil and the amount of sewage to be

purified. For a family of five, if the soil be reasonably porous, a plat of ground 40 feet by 50 feet should be ample.

The third method of exposing the liquid wastes to the action of the bacteria is used when the available area of the land is limited or if on account of the character of the soil too large an amount of drains would be necessary to handle the sewage to be purified. Under these conditions specially prepared beds of sand, gravel, or screened cinders are used as a filter material. The sizes of these beds vary with the amount and character of the sewage and its previous treatment, but for a family of five under reasonable conditions and a proper preliminary treatment, a bed 25 feet long, 4 feet wide and 4 feet deep should answer, altho one 5 feet deep would give a purer effluent.

COLLECTING THE LIQUID WASTES.

As has been pointed out in the previous paragraphs, intermittent application is the key to success, and in order to apply the liquid waste or sewage to the land intermittently it is necessary to collect the irregular flow from the house in some manner.

The house drain or sewer.—The house drain of cast-iron pipe extends at least 5 feet outside of the foundation wall. From this point to the collecting chamber vitrified sewer pipe is used, except in made ground or in quicksand or where the drain must pass near a well, when cast-iron pipe should be provided. The drain should be given a uniform fall if possible, and should be at least 3 feet below the surface in cold climates, to avoid freezing. The greater the inclination the less the liability of obstruction. A fall of 1 foot in 40 or 1 foot in 60 feet is desirable; 1 foot in 100 feet is the least that should be used unless special flush tanks are provided. The bottom of the trench should be dug to the exact grade and shaped to fit the lower half of the pipe, with grooves cut for the sockets, as shown in figure 8. Inspection and cleaning hand-holes should be located about every 50 feet, and their exact location marked on the plan of the drain, to aid in locating obstructions, if any should occur. Change of direction of the pipe line should be made with special curved pipes of large radius.

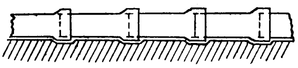


FIG. 8.—Method of laying vitrified pipe.

Making the joints.—The joints of the pipe should be well made. The space between spigot and hub should be filled first with a small rope of picked oakum, rammed into place with a hand iron to prevent any cement mortar from entering at the joints. Then fill the remainder of the space with a mortar made of one part Portland cement and one part clean sand. The cement and sand must be thoroly mixt dry and wetted up only as needed. The bottom of the joint should be made

with particular care, using the fingers to press the mortar into place. As soon as the joint is finished the groove in the trench should be filled with earth to prevent the joint being broken before the cement has time to harden. The inside of the pipe must be thoroly cleaned from projections of oakum or cement. If the drain passes close to trees the joints should be surrounded by concrete to protect the pipes from the roots of the trees. Before refilling the trench the joints should be tested by closing the main outlet and filling the pipes with water. Leaky joints are undesirable, both because of the contamination of the soil and because the liquid is needed to carry the solid matter thru the pipes.

Volume of sewage.—The volume of the sewage is practically equal to the water consumption. The waste matter received increases the volume very little, 1 pound in 120 gallons is organic matter, to remove and destroy which is the purpose of the "disposal plant." The garbage or kitchen refuse of course is not included. This 1 pound of organic matter with its 120 gallons of water is all carried by the house sewer to a suitable place, the distance from the house varying with the surrounding conditions, and collected in a chamber to which has been given various names, according to the manner of use proposed. We have the "flush tank," the "settling chamber," and the "septic tank," and these may be so constructed and used that it is difficult to draw an exact line between them.

FLUSH TANKS.

A flush tank may be built of brick or of concrete, and is designed simply to collect the irregular house flow in order that it may be applied to the land at intervals varying from twelve to twenty-four hours. The size of such a tank depends upon the number of persons in the family using the water supply, which again varies with the habits of the family. The report of the data collected upon the use of water in the city of Columbus, Ohio, where 80 per cent of the houses are metered, states that the amount of water used per capita per day varies from 60 to 100 gallons.

A Simple Flush Tank.

The simple flush tank shown in figure 9 is designed for a family of six, using 60 gallons of water each per day. If the flush tank is to empty in twenty-four hours, the tank must be designed so the siphon will empty it when 360 gallons of liquid matter are collected. Counting 231 cubic inches to the gallon, the capacity of the tank must be about 48 cubic feet. The depth at which the liquid will stand in the tank will be determined by the action of the siphon. The automatic

siphon shown with this design will hold the sewage to a depth of 1 foot and 3 inches. Whenever the tank fills to the discharging line the liquid is set in motion thru the siphon, and when the tank is empty the siphon "breaks," and no further discharge takes place till the tank is full again. The depth of the sewage being fixed by the siphon selected, in this example at 1 foot and 3 inches, the area of the tank must be 38 square feet to hold the estimated flow. A width of 4 feet and a length of 9 feet gives about the required capacity.

Construction.—This tank is built of concrete in the proportions of 1 part of Portland cement, 2 parts of clean sand, and 4 parts broken stone or gravel. If the sand contains both fine and coarse grains so much the better. The broken stone or gravel should vary in size from $\frac{1}{4}$ inch to 2 inches in longest dimension, and the more variation within these limits the better.

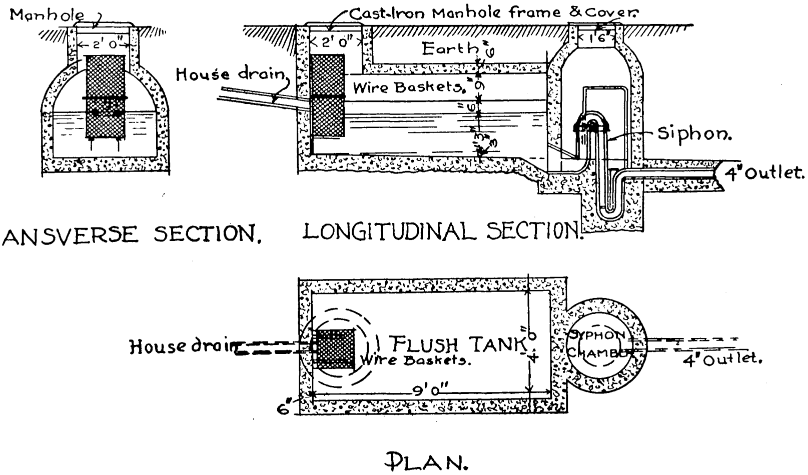


FIG. 9.—Simple flush tank.

Care should be taken to make the excavation just equal to the exterior measurements of the tank, in order to save material. Slope the bottom toward the outlet and cover it with 4 inches of concrete for the floor of the tank. Set the outlet while the floor is being laid. Build the interior form as shown in the sketch (fig. 10), using wood screws in construction, as pounding to remove might injure the concrete. This framing is set on the floor when the cement has hardened. Inch boards are used to complete the form, and are put in place as the wall is carried up. The concrete is put in in layers from 8 to 12 inches deep, and is thoroly rammed with a 4-inch or 6-inch rammer, which weighs about 20 pounds. The inlet pipe must be set at its proper elevation. When the top of the uprights is reached segments of circles are supported on them, as shown by dotted lines in the sketch. These have a rise of about 9 inches, and should be fastened to the uprights

in such a way that they can be readily removed, and so that they will not interfere with the bearing of the top on the side walls. The boards placed on these must be narrower, say 6 inches, and the concrete must be mixt somewhat wet, as little tamping can be done, only enough to exclude the air. This arch should be at least 5 inches thick. The manhole can be built by using sheet-iron forms, made so they can be expanded or contracted in removing them. A 4-inch space between these should be sufficient. The manhole walls are carried up to the surface of the ground. After a few days the forms are removed and the interior is plastered with a mortar of one part cement to two parts clean sand. If the boards have been given a coating of soft soap they will be the more easily removed from the concrete walls. If at any time in building up the walls fresh concrete is to be deposited upon that which is already set the surface of the old work should be cleaned and wet and coated with a mortar made of one part cement and one part clean sand. This precaution should also be taken at the joining of the sides to the bottom of the tank. For a water-tight tank it is better to lay the walls without such joints. Where the side walls are to join the bottom of the tank the concrete should be roughened after being rammed for the floor, and a 1 to 1 mortar spread over this roughened surface when beginning to build the side walls.

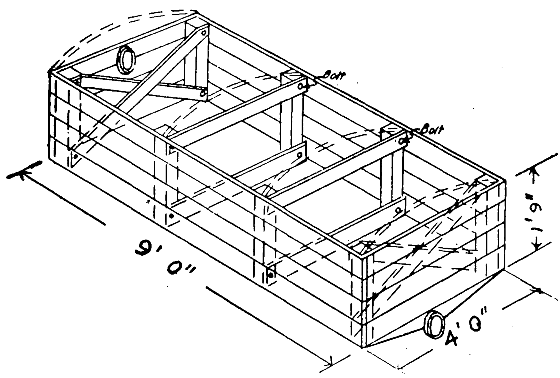


FIG. 10.—Form for concrete flush tank.

The cost of the materials for the concrete in this tank will vary in different localities. If Portland cement is bought at 44 cents a bag, sand at $1.50 a cubic yard, and broken stone at $4 a cubic yard, an approximate estimate of the cost of the material would be $23.

Use of screens.—When a simple flush tank like this is used, paper and such coarse material should be screened out at the inlet. This is accomplished by having two baskets (16 by 16 by 16 inches) made of diamond-mesh wire cloth woven of No. 12 wire, one to the inch, with an opening near the top at one side to receive the inlet pipe. Hooks are provided on the side wall to hold the basket in place, and as the sewage passes thru the paper any solid matter is retained. The second basket is used as an alternate when cleaning is necessary, which should be done once a week. A very small residue will be found in the basket, and this should be removed and spaded into the ground.

The basket retains all material that would be unsightly if scattered over the surface of the ground or might obstruct the draintile in the case of subsurface disposal. A single-chambered flush tank is not advisable in most cases for subsurface irrigation. The draintile would need to be taken up and cleaned out more often than when a settling chamber is used.

Open tanks.—These tanks may be built of brick and plastered inside with cement mortar. If desired, they can be built near the surface of the ground and left open. In this case wire-cloth screens built in sections should be furnished to protect the contents against leaves and rubbish. If an open tank is desired, it would be well to build it not more that 2 or 3 feet wide and get the cubic contents necessary to contain the daily flow by increasing the length, as the narrow tank is

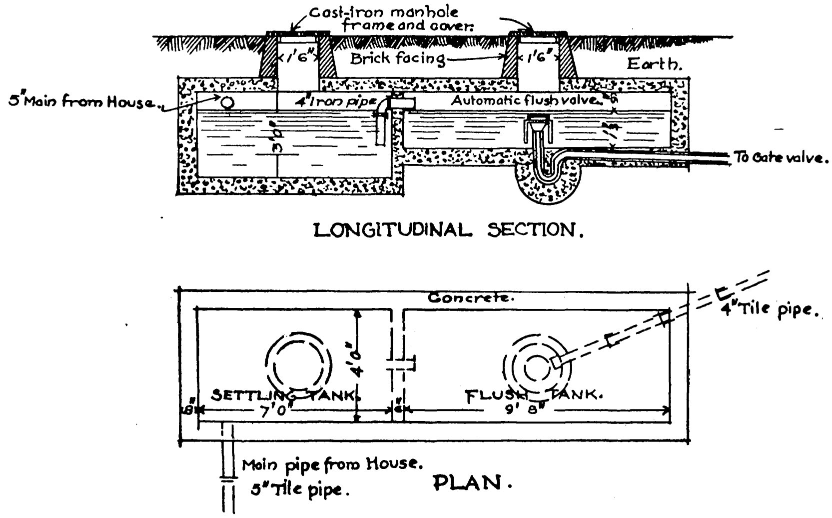


FIG. 11.—Double-chambered flush tank of concrete.

desirable to prevent the screens from sagging. If the walls are occasionally swept down after the tank has discharged no odor should be noticed in the neighborhood, and its location near the house could be objected to only for esthetic reasons. A tank which is open will be more likely to freeze over on the surface. To prevent this frames covered with boards might take the place of the screens in winter. The danger from freezing is not great, as the sewage is warm when it comes from the house.

Double-chambered Tanks.

For subsurface disposal it is necessary in most cases to provide a double-chambered tank, the first chamber to retain the solid matter and scum until they dissolve, and the second chamber to accumulate

the liquid wastes and discharge them intermittently by means of a siphon.

Description.—One type of the doubled-chambered tank is shown in figure 11. This tank was designed to take the place of two overloaded cesspools, which were creating disagreeable odors. The amount of sewage to be disposed of daily was estimated from the amount of water used by the family of five, the water supply being distributed thru the house from a 580-gallon tank in the attic, which is filled about every other day by means of a hot-air pump. The flush tank was designed to take care of 350 gallons, or 70 gallons per capita per day. The pipe connecting the settling chamber with the flush tank is arranged to draw the liquid from midway between the surface and bottom of the settling chamber, so as not to disturb the solids that have settled to the bottom of the tank or the scum that floats on top. All sewage coming from the house passes into the settling chamber, where the solid matter to a greater or less extent is deposited. Owing to the character of the sewage, the decomposition of the solids is so active as to prevent any serious accumulation in the bottom of the settling chamber. It is necessary to inspect the chamber from time to time, and if undissolved solids accumulate to have them removed, probably about once a year. This accumulation when removed should be carried to the field and spaded into the soil at once.

Construction and cost.—This tank was built of concrete in a manner very similar to that previously described for the single-chambered tank. The manholes were built of brick, and the siphon placed directly under one of them for convenient access to it. The cost of the material for this tank, including the siphon and cast-iron manhole covers, was $51.61. The lumber for the forms costs $9.85.

Figure 12, on the next page, shows an inexpensive collecting chamber designed by Prof. Anson Marston, of the Iowa State College. The septic tank is arched over with brick and only the two manhole covers appear on the surface of the ground. The screen of fine pebbles and of sand retains all solid matter in the septic chamber, and on account of the upward action of the sewage the screen does not become clogged. The siphon chamber will vary in size, depending upon whether a sand filter or subsurface irrigation is used for the second step in the purification of the sewage. With a sand filter the siphon chamber could be emptied in eight hours; with subsurface irrigation, in eighteen to twenty-four hours.

SUBSURFACE IRRIGATION.

It has already been explained that only the upper layer of the earth contains air enough to allow of the bacterial action necessary for sewage purification, and also that nature has her limits and must not be

overworked; hence, there must be an intermittent application of the sewage or the process of purification will cease altogether. Altho the sanitary results would be accomplished by surface irrigation the character of the soil may allow and the requirements of the family demand the distribution to be beneath the surface.

Use of draintile.—To secure subsurface disposal 3-inch agricultural draintile are laid with open joints, the bottom of the tile coming within 8 to 12 inches of the surface of the ground. These drains should be laid nearly level or with a very slight fall, say 2 inches in 100 feet. If too steep the lower part of the field will be flooded. The ground should be naturally or artificially so well drained that water will descend thru it readily, and porous enough to admit the air.

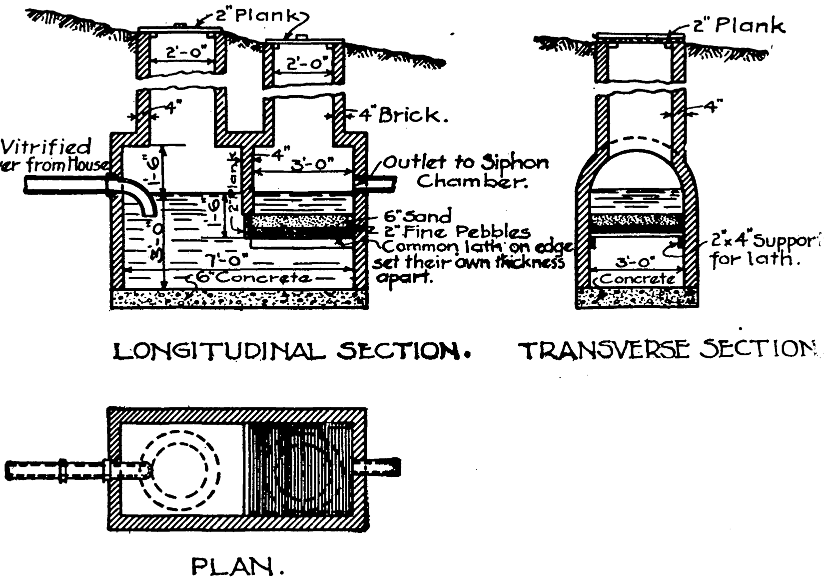


FIG. 12.—Double-chambered tank of brick.

If the subsoil is not porous enough to remove all the water settling thru the upper layers it should be underdrained by lines of 4-inch tile spaced from 25 to 40 feet apart. If a suitable outlet can be had these underdrains will do better work if placed 5 feet below the surface, altho 4 feet will answer. The outlet should run perfectly free.

Adaptations to different soils.—The most suitable soil is a sandy loam, while clay and peat are the most unsuitable; altho heavy clays can be used, where nothing else is available, by good underdraining and by filling the distributing trenches, after laying the tile, with sand, gravel, or fine cinders. The drainage will improve with time and the soil be able to purify an increased amount of sewage. The length of tile required for distributing the sewage will depend upon the porosity of

the soil. For a porous soil 1 foot of tile for each gallon of sewage should dispose of the liquid. If the soil is heavier the length must be increased. For clay there should be at least 3 feet of tile per gallon.

Different methods illustrated.—Figures 13, 14, and 15 show different methods of laying out these drains, depending upon the slope of the ground. In figure 13, the double-chambered tank is located in the side lawn about 70 feet from the house. A 4-inch vitrified sewer-pipe line, laid with cemented joints, connects the flush tank of 300 gallons capacity with the gate valve (fig. 16), and two distributing lines of 3-inch draintile, each about 450 feet long, are connected to this gate valve. The character of the surface determined the direction the lines should take to give them the very slight fall required. The

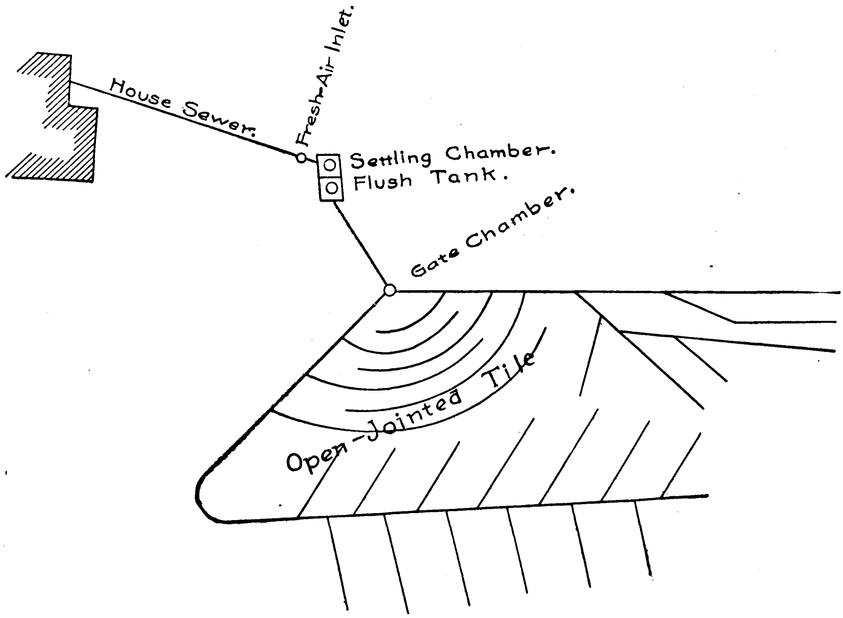


FIG. 13.—Subsurface irrigation for slightly sloping ground.

joints were first covered with paper to keep the dirt out of the tile until the soil became compact. The trench was partially filled with crusht stone, after the tile had been laid, to increase the porosity of the soil, and then completely filled with earth and the sods replaced. (See fig. 17.) At the end of each branch a little pocket of stone was placed. This system was designed to have the flush tank empty about every twenty-four hours. The distributing systems were to be used alternately, a week at a time. The gate used to change the flow from one line to the other was operated by hand, being swung from one side of the cast-iron cylinder to the other, which took about one second of time. By this means one drain is given a complete rest of a week to allow the purification of the soil.

Four and one-half cents a foot was paid for this draintile, and the price paid for the gate valve was $10, making the material for this subsurface system cost $46.50.

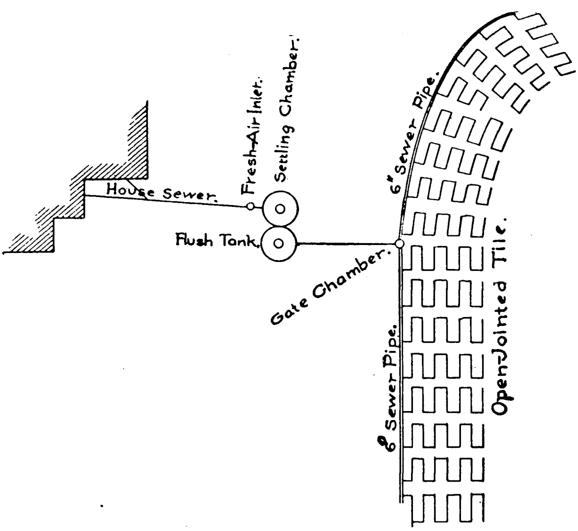


FIG. 14.—Subsurface irrigation for steep hillside.

Figure 14 shows another subsurface system. The settling chamber and flush tank are located about 40 feet from the house. There is an advantage in placing these as close to the house as practicable. If there is any tendency for sediment to collect in the sewer, the shorter this part of the system is made the less chance there is of trouble from the stopping up of the sewer. If the system is in good working order there should be no odors. The distributing system was located on a very steep sidehill, which accounts for the method of laying the drains so as to have the branch lines of about the same length, and the average fall not much more than 2 inches in 100 feet. The 6-inch sewer pipe is laid with cemented joints, with a fall of 4 inches to the 100 feet each way from the dividing chamber. To completely empty the 6-inch sewer pipe the 3-inch drains should connect with the 6-inch pipe at the bottom, as shown in figure 18.

A subsurface system adapted to level ground is shown in figure 15. The two underground tanks are used for the sewage and a separate chamber is provided for the siphon. These tanks are placed within 15 feet of the house. As nothing is visible except the iron cover of the tanks and the system is water-tight to the place where the disposal tiles are laid, there is no sanitary reason that would require an increased distance. The tile lines

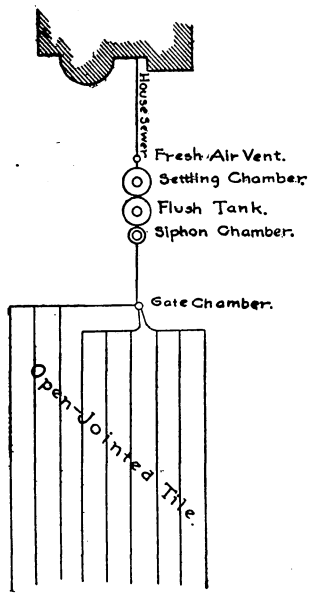


FIG. 15.—Subsurface irrigation for level ground.

are divided into three series leading from the gate chamber, so that the ground utilized by two lines is given a complete rest while the other line is in use.

DISPOSAL BY FILTRATION.

Filtration is only a more copious irrigation. The principle of purification is the same. The sewage must still be applied intermittently to allow of the renewal of the oxygen in the filter, and a preparatory

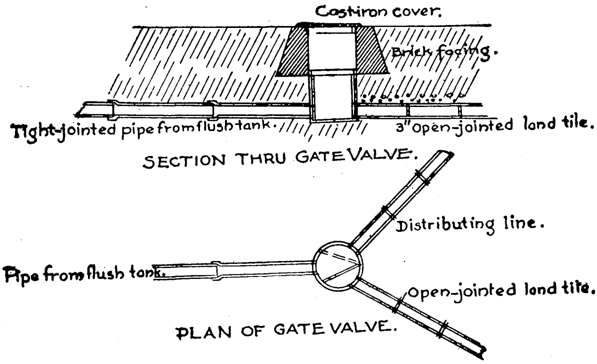


FIG. 16.—Plan of gate valve.

treatment to remove the coarser organic matter is necessary to prevent deposits upon the surface of the filter beds. An increased quantity of sewage will be purified if the surface of the filter is raked over to the depth of an inch every week. Filters 2½ feet deep require more attention than those of greater depth, but with proper care they serve their purpose well.

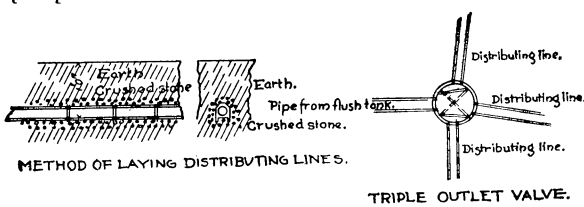


FIG. 17.—Method of laying distributing lines.

A sand filter becomes more effective the longer it is in use, if the surface is kept in good condition. For a family of five, a filter bed with a surface of from 200 to 400 square feet should give an effluent that is clear and odorless. Smaller beds can be used, but it means more care in keeping the filters clean and free from clogging, especially in winter. The filtering material should be 3 to 5 feet deep and should be well underdrained. The experiments carried on at Columbus, Ohio, indicate that the best preparatory treatment to be used with filtration methods was afforded by the septic tank, which would hold an 8-hour

flow. From these experiments it would seem that the capacity of the flush tank could be reduced at least one-half if a filter bed was to be used instead of subsurface irrigation. A section of a filter bed is given in figure 19.

To secure an even distribution over the entire surface of the bed, a 6-inch galvanized roof gutter, pierced every 3 inches with ¼-inch holes, could be laid on the surface extending the entire length. Four-inch draintile laid with open joints could be used, or a wooden trough having openings every 2 feet on each side.

SURFACE IRRIGATION.

The sewage of a house that has a complete water carriage system is not offensive at first, because the organic matter is so small a percentage of the entire amount. If the liquid wastes can be discharged upon the surface of the ground without undue retention, this method of disposal will be without offense and entirely effective. Where plenty of land is available it is by far the cheapest and simplest method that can be used. A series of outlets should be provided to avoid saturating the ground and, as in subsurface irrigation, the application should be intermittent. This is obtained by the use of a flush tank discharging automatically by means of a siphon into a pipe leading to the disposal ground. The number of the outlets will depend upon the slope of the ground and the amount of the discharge, but it is well to have three groups of outlets to be used in succession, allowing several discharges upon one field before the gate is changed to bring another group into use. A gently sloping surface of grass land is adapted to this form of disposal without any previous preparation, except the placing of a small platform of stones or brick laid close together at each outlet to prevent the washing away of the earth and aid in spreading the flow over a greater area. The flush tank should be designed to discharge in from twelve to twenty-four hours by means of an automatic siphon.

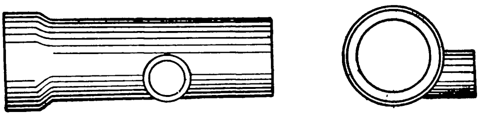


Fig. 18.—Distributing-tile connection.

CARE OF THE DISPOSAL PLANT.

It must not be expected that once a system is installed there is nothing more to be done. Any method of disposal will require a slight amount of regular attention, but the results will amply compensate for the time and the money expended. Every part of the system, including the siphon, needs attention and occasional cleaning. Of all methods devised by the sanitary engineer for purifying sewage its application to land has secured the best results. While this method

can not be used by many cities on account of the impossibility of securing a sufficient amount of suitable land, it is especially adapted to the needs of the farm.

DISPOSAL OF ASHES, GARBAGE, AND MISCELLANEOUS REFUSE.

It is the regular taking care of the little things that advances housekeeping to a fine art. The more promptly and regularly all refuse of the household is harmlessly disposed of the better for the healthfulness and comfort of the home. If the ashes are kept free from organic wastes they can be used to advantage on the garden walks or to fill up low places. When taken from the stove or furnace they should never be stored in wooden boxes or barrels or in a fixt ash pit, but in a galvanized can, not too large to be easily emptied, that is

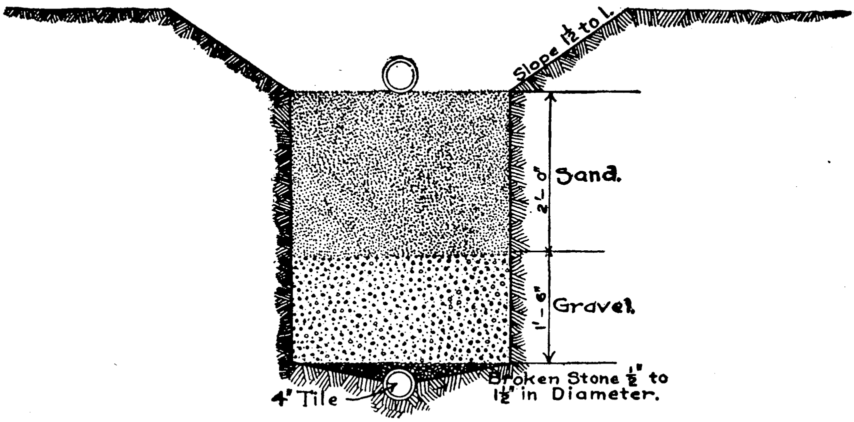


FIG. 19.—Section of filter bed.

fitted with a tight lid. Many serious fires have been started from the inexcusable carelessness of using a wooden receptacle for ashes.

The kitchen refuse from the preparation of the food can be saved for the pigs and chickens. It should be collected in galvanized-iron pails furnished with tightly closing covers to prevent exposure to the sun and to avoid flies. These pails should be washt and scalded each time they are emptied, and once a week, especially in summer, they should be rinsed with carbolic acid—a teaspoonful to a pint of water. Whatever can not be used in this way should be dried and burned.

Things that the junk peddler will take (old tin, iron, leather, rubber, etc.) should be cleaned and stored in sacks in a dry outhouse to await his next visit. No damp or decaying rubbish should be left in dark or out-of-the-way places.

HEATING SYSTEMS.

THE IDEAL SYSTEM.

The health and comfort of the home depends to a considerable extent upon the heating apparatus, which, in importance, is second only to that of sanitary plumbing. Stoves are a development of the fireplaces of our ancestors. Their waste of fuel, their uncleanliness, and their inability to properly heat even one room are features recognized by most people. The ideal heating apparatus is one that will promptly and continuously supply every room in the house with enough warm fresh air to make it comfortable in the coldest weather. It must be easy to manage and not complicated in construction. The cost of installing a steam or hot-water system is more than that of a hot-air furnace. The amount of fuel used by them is less, but for a small house the hot-air furnace is most often used. It has the advantage, too, if properly installed, of supplying fresh air, while the other systems demand special means for ventilation, or dependence must be placed entirely upon opening the doors and windows.

FURNACES.

A furnace is a stove within a casing of galvanized iron or brick. Air is admitted to the space between the two and when it becomes heated passes thru pipes to the different rooms of the house. The furnace may be constructed of cast iron, wrought iron, or steel. The cast-iron furnace has fewer joints than the one made of steel plates and will not vary in temperature so rapidly.

Direct and indirect draft.—In construction there are two styles, the "direct" and the "indirect" draft. The better class of the "direct" draft furnaces have a radiator thru which the hot gases pass on their way to the smokestack and so utilize much heat that would otherwise be lost. In the "indirect" draft furnaces the gases pass thru radiators at the bottom and from there to the smokestack. A direct passage is furnished to be used when the fire is being started or when coal is being added. Some furnaces are "built to sell" by their size and are not furnished with a radiator. These will burn more fuel and give off less heat.

The smoke pipe.—The smoke pipe should connect to the chimney as directly as possible, for elbows diminish the draft. The flue should be at least 8 inches by 12 inches and should have no other opening into it for range or fireplace. A clean-out door should be provided at the bottom, fitted with a tight door, and this door must be kept shut, except when cleaning out the flue.

The grate.—The grate is one of the most important parts of a furnace, and there are many kinds to be had. The essential things are

the removal of the ashes and cinders from the entire grate surface without carrying unburned coal with them, and the admission of air to secure proper combustion of the fuel. In comparing furnaces the average diameter of the fire pot is taken. The space above must be large enough to permit of the thoro mixing of the gases with air or else much heat will be lost by imperfect combustion. If soft coal is to be burned a larger combustion chamber is needed than with hard coal, as the supply of air must be greater.

Furnaces differ in the manner of bringing the air to be warmed into contact with the surfaces heated by the combustion of the fuel. The area of the heating surfaces should be about 60 times the area of the grate surface to prevent overheating of the air in cold weather.

Where natural gas is available the furnace can be arranged to burn it, but it is well to have a coal grate also in case the gas should be shut off. Wood furnaces are generally more simple in construction and are often built to take a 4-foot stick. Where wood is cheap excellent results may be obtained. The smoke should pass thru a radiator, as in case of coal furnaces.

Distribution of hot air by means of pipes.—Much depends upon the location of the furnace. It should be placed somewhat to the north and west of the center of the house—that is, toward the prevailing cold winds. As the hot air travels best thru the pipes leading toward the sheltered part of the house and to the upper rooms, the pipes leading toward the north and west or to the rooms on the first floor should be given the preference with respect to length and size. Make all pipes as nearly the same length as possible and as short as the location of the registers will permit. Long horizontal runs of pipe should be avoided, especially in first-floor pipes. The pipes should pitch upward as sharply as possible so the resistance will be less. Each pipe should have a damper near the furnace. Each room should have a separate pipe, if possible, or the heat will go to the less-exposed room when a wind is blowing. Exposed pipes should be provided with an asbestos covering, even when made double; double pipes are the best for all work. Bright tin is almost always used for hot-air pipes, as it radiates less heat than any other suitable material. The registers should be as near the furnace as possible. Nothing is gained by putting them on the exposed side of the room and much heat is lost. First-floor registers may be placed in the floor if wall registers would interfere with the pipes to the second floor. Second-floor registers should be placed in the wall so as to avoid the necessity of cutting carpets and not to furnish receptacles for dirt. If only the first floor is heated the registers should be placed in the wall. The net area of the register should be about 15 per cent greater than the section of its hot-air pipe.

Size of pipe to use.—The size of the room and whether it is a bedroom or living room; the run of pipes, whether short or long, straight

or crooked, vertical or horizontal, should all be considered in determining the size of the hot-air pipes. Pipes can be too large, but more often they are too small. When in doubt, use the larger size. For first-floor rooms up to 12 feet square and 10-foot ceiling, 9-inch pipes should serve; for larger rooms up to 14 feet by 16 feet with 10-foot ceilings, use 10-inch pipes; and for rooms still larger, 12-inch pipes. Sleeping rooms and bathrooms on the first floor need 8-inch pipes. If any pipe is poorly located a size larger should be used.

The cold-air supply.—The cold-air supply pipe should be made of galvanized iron, as it will then be dust and fire proof and more durable than if made of wood, which cracks and admits the dust and the close air of the cellar. If it is made of wood, matched boards should be used and the wood should be stopt at least a foot from the furnace. The size of the cold-air pipe is often made equal to three-fourths the combined area of the hot-air pipes, as air expands when heated. It should never be smaller than this and might be made of the full area of the hot-air pipes. If not enough cold air is supplied, the pipes

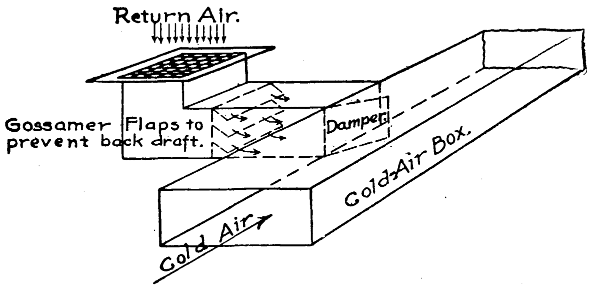


FIG. 20.—Return air pipe.

leading to the sheltered side of the house will take all the air and even draw down air from registers on the windward side. In attempting to warm these unfavorably located rooms in extreme weather the air must be overheated, which is hard on the furnace. In localities where zero weather is frequent, a pipe is often provided to return the air of the house thru the furnace. The area of this pipe should be equal to the combined areas of the hot-air pipes. This pipe is not to take the place of the fresh-air inlet, but can be used part of the day without harm. If used at all, it must be used intelligently, or else the saving of fuel is at the expense of health and comfort. When a return-air pipe is used, it often joins the fresh-air inlet pipe, as shown in figure 20. If this combination is installed, the pipe is full size from the furnace to where the inside supply pipe is connected and three-fourths size from there to the outside air. Both pipes should be provided with dampers. It is often necessary to shut off part of the cold-air supply to start the fire, but the full supply should be turned on as soon as possible or air will be taken from the cellar or from some of the registers. If it is found that some registers do not deliver enough warm

air while others supply too much, the dampers can be adjusted to cut off part of the flow from rooms that have more than their share, which will throw it into the less favored pipes.

Rooms having fireplaces are more easily heated than others. All rooms not having fireplaces should have ventilators with pipes of half the size of the warm-air inlet and pipe, the opening being near the ceiling on the same side of the room as the warm-air inlet, but as far as possible from it. All these pipes should unite in the attic and have a common outlet, preferably surrounding the chimney, as the heat from the smoke flues will induce a draft.

If the furnace is of sufficient size and is properly located and the fittings well put up, it should give no more trouble than a single stove, while the risk from fire is much less. The satisfaction of a warm house, especially of warm floors, can not be counted in dollars and cents.

Regulating the dampers.—An arrangement for regulating the dampers by hand can be placed in any convenient room on the first floor, which will reduce the labor of caring for the furnace by half, or an automatic temperature regulator can be used, which will not only secure an even temperature with less fuel but will avoid the strain on the furnace caused by forgetting to close the dampers after the fire is started until reminded of it by the excessive heat of the room. An alarm clock with a ratchet or gear arranged to trip a lever and allow the weighted damper to open is often used to turn on the drafts in the early morning.

If the house has a fireplace or two, it is not necessary to use the furnace so early in the autumn or so late in the spring, as a small grate fire in the mornings removes the chill from the rooms with less expenditure of fuel. A good fireplace is a precious possession.

EXAMPLES OF HOMES WHERE SOME MODERN CONVENIENCES HAVE BEEN INSTALLED.

From the many country homes where advantage has been taken of improved appliances for comfort and the saving of labor a few have been selected as illustrations of the cost of introducing such conveniences. The cost has been furnished in each case by the owners.

One two-story house of 8 rooms has a hot-air furnace, with registers in 7 rooms. A range was used in the kitchen, so no other heat was needed there. The furnace was furnished and installed for $150. The cost of the coal used in both range and furnace has averaged about $54 a year for the last four years. The following plumbing fixtures were set up, with complete supply and waste pipe connections as far as the outside of the house, for $180: In the bathroom, lavatory, bath tub, and water-closet; a lavatory in one bedroom; in the kitchen

a sink and a 30-gallon range boiler; a cold-water faucet in the laundry, and a sill cock for the hose outside the house.

A six-room cottage has a hot-air furnace, with registers in every room, which was furnished and installed for $133. From two rooms the heat is shut off part of the time, and coal is not used in the kitchen range. The cost of the coal per year has been $36. Water is supplied to the plumbing fixtures thru a tank in the attic. The cost of the attic tank, the bathroom fixtures, which consist of bath tub, lavatory, and water-closet; the kitchen sink and hot-water heating tank, with connections to walls of house, was $115.

A home in central Iowa has a pneumatic tank 8 feet long and 30 inches in diameter in the cellar. This tank is supplied with water and some air by a windmill, erected in common with two neighbors. There is in the cellar a smaller tank of 66 gallons' capacity, connected by a hand force pump to the rain-water cistern. Three or four minutes' pumping with the hand pump every day supplies a good pressure on the cistern water. The soft-water tank supplies a 30-gallon hot-water boiler, which is connected with a hot-water coil in the furnace and with a gasoline heater in the cellar. The plumbing fixtures consist of a sink in the kitchen and a bath tub, lavatory, and water-closet in the bathroom. Each fixture has 3 faucets containing, respectively, cold well water, cold cistern water, and hot cistern water. The three pipes are run to the laundry and faucets set. The cost of the entire plumbing, including connections to windmill and to rain-water cistern, hand pump for cistern, steel tanks and all, but not including a share of the windmill and deep well, was $300. The heating system consists of a hot-air furnace with registers in every room, there being 9 rooms and halls in the house, including kitchen and third-story room, and cost $200 to install. The average cost of fuel per year is $75.

A five-room cottage is heated with a hot-water system installed by the owner. The cost of material and fittings was under $200. In four years the additional cost for repairs has been $20.65. The whole house is kept at about 70° F., and the cost for soft coal has never exceeded $38.50 for the whole firing season.

The advantage in the hot-water system is in the fact that the water begins to circulate thru the pipes as soon as the fire is built and the radiators will retain heat from five to ten hours after the fire is out.

The first-floor rooms of one home are heated by using a large wood stove in the cellar. This stove is large enough to take cord wood in full length. It is walled in with brick, and pipes lead from this hot-air chamber to the various rooms. This method gives "splendid satisfaction."

A furnace with six registers was put into an old two-story house at a cost of $125. One of the old chimneys was used for a fireplace. The grate and the tile front cost $17, and a carpenter put in the

wooden frame and mantel shelf for $10. The cost of the coal per year is from $43 to $50.

Figure 21 shows a plan of the water-supply and sewage-disposal

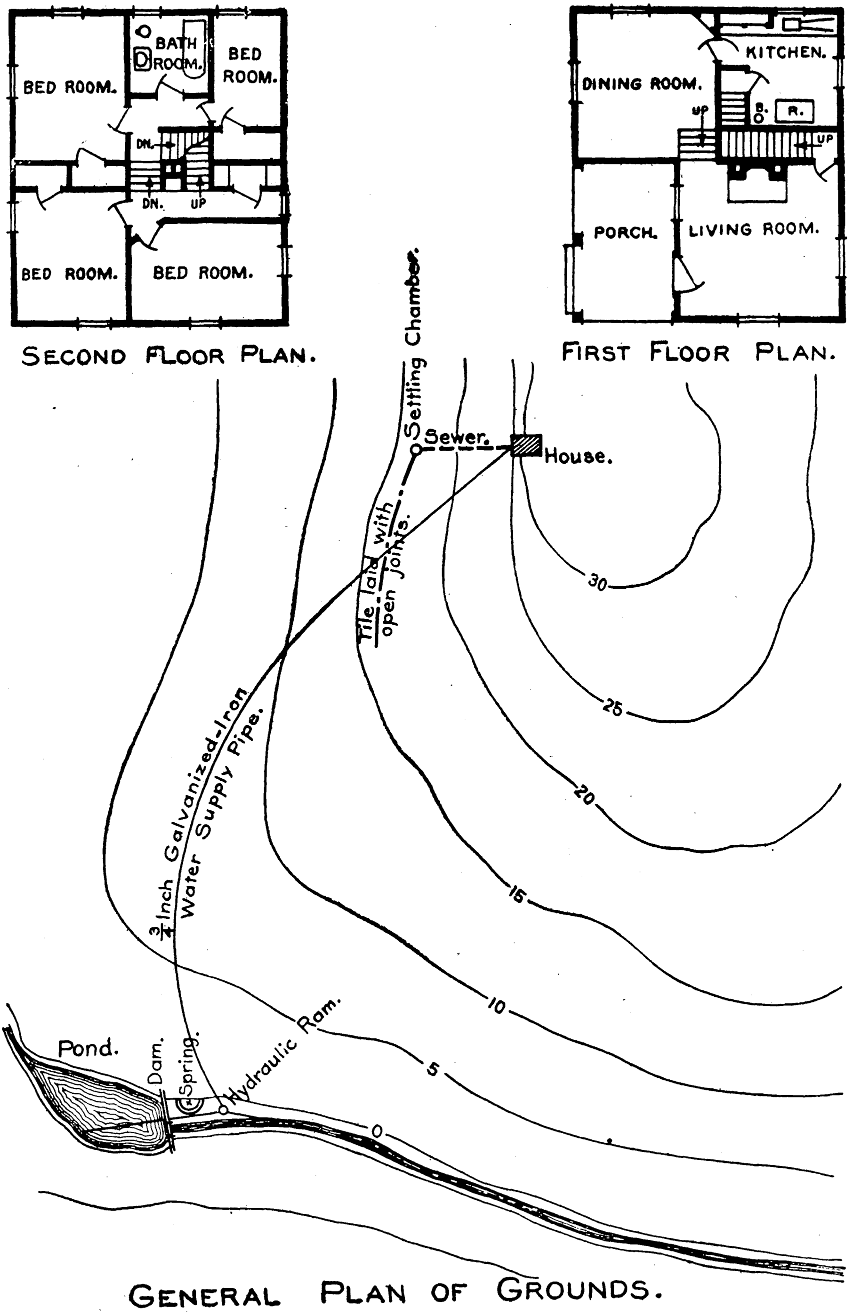


FIG. 21.—Water supply and sewage disposal for a small farm.

system for a cottage near Chappaqua, N. Y. By building a stone dam about 30 feet long, a brook was made to give a head of 6 feet 2 inches for a compound ram located a few feet below the dam. The water from above the dam flowing thru the drive pipe forces spring water thru 650 feet of ¾-inch pipe to a 65-gallon galvanized-iron tank in the attic of the cottage, at an elevation of 87 feet above the ram. The overflow from this tank wastes into the drain for the rain-water leaders. Water is piped from the attic tank to the bath tub, lavatory, and water-closet tank in the bathroom and to the sink and 30-gallon hot-water boiler in the kitchen. The boiler is connected to a water back in the kitchen range and hot water is piped to the kitchen sink, to the bath tub, and lavatory. One line of soil pipe collects all the liquid wastes. About 10 feet outside the foundation wall this cast-iron soil pipe connects to a 4-inch vitrified-pipe sewer, leading to a 50-gallon settling chamber, 75 feet from the house. The effluent from the settling chamber is emptied into a line of 4-inch drain tile laid with open joints and with a very slight fall, about 10 inches below the surface of the ground. The cost of the entire system was about $200. The plumbing fixtures were procured at cost; the owner was his own superintendent, and used unskilled labor at $1.50 per day.

POSSIBILITY OF INTRODUCING MODERN CONVENIENCES INTO HOUSES ALREADY BUILT.

It goes without saying that both plumbing and heating systems can be put into a house more conveniently at the time the house is being built; but if this has not been done there is nothing to prevent their being installed afterwards. The hot-air pipes from the furnace to the second floor can not always be concealed in the partitions, but a round pipe in the corner of a room can be covered with the same paper as the walls and will not be so unsightly as the usual stovepipe nor take up as much space as a stove. Little inconvenience is found in putting in the registers for the first floor.

The installation of the plumbing may conflict with the routine of the household for a week, but as all pipes should be exposed, for sanitary reasons, aside from cutting thru ceilings and floors little inconvenience is met with in putting the pipes and fixtures in place. A water back can be fitted to almost any kitchen stove to supply heat to a small boiler, or a water coil can be placed in the combustion chamber of the furnace, which will furnish a more abundant supply during cold weather, and an independent heater, built to use any desired fuel, can be employed when there is no fire in the furnace. The waste water and sewage disposal system can be built just as well to connect to an old house as to a new one, especially if no fixtures are placed in the cellar, and cellar fixtures should be avoided if possible, especially open drains in the cellar floor even if trapt.

Figure 22 gives a general plan of the buildings on a farm in the Santa Clara Valley, California. As the contour lines show, both barn and privy are on ground higher than the surface of the well, the privy

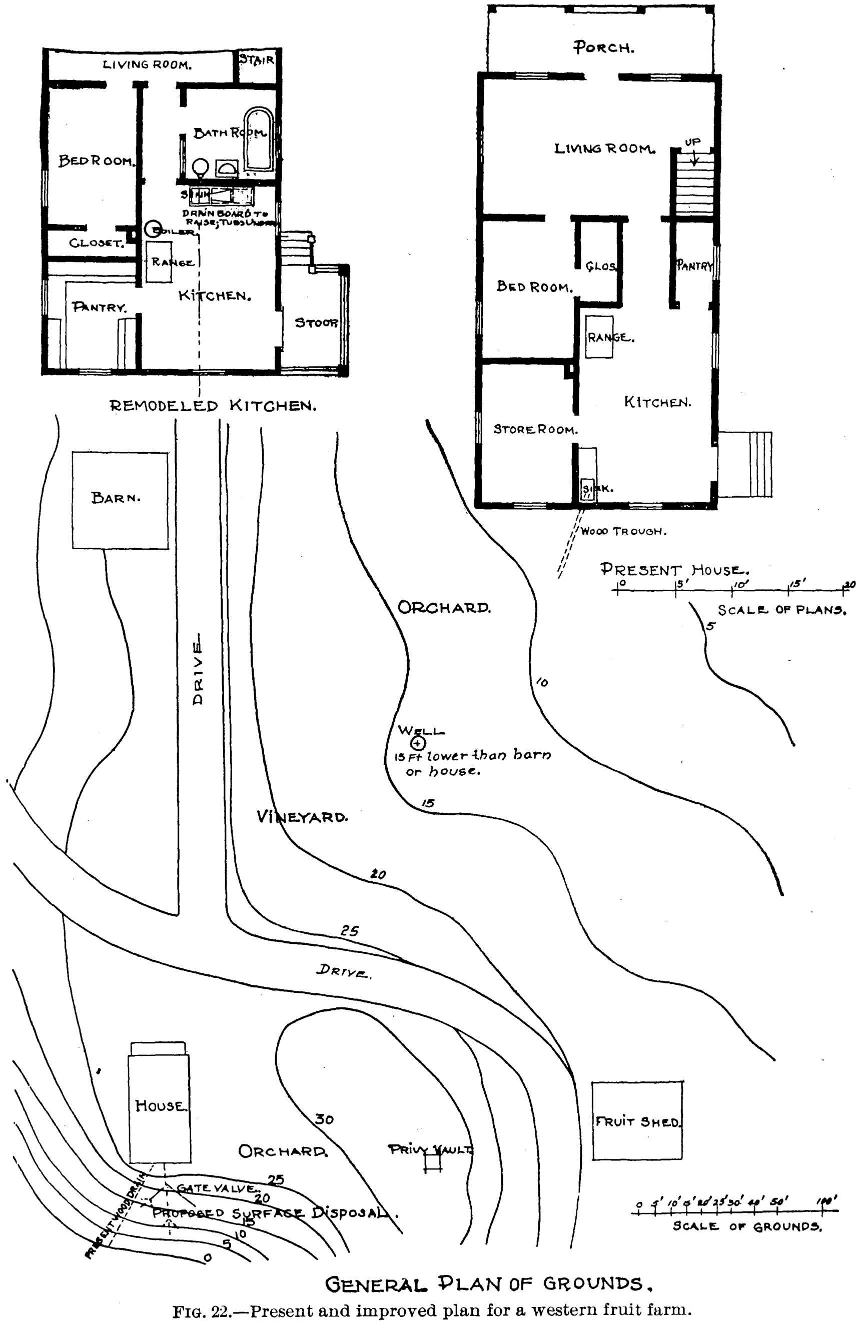


FIG. 22.—Present and improved plan for a western fruit farm.

being on ground higher even than that upon which the house stands. The privy vault is never cleaned, but ashes and lime are used once in awhile, and when the old vault becomes full a new one is dug. The

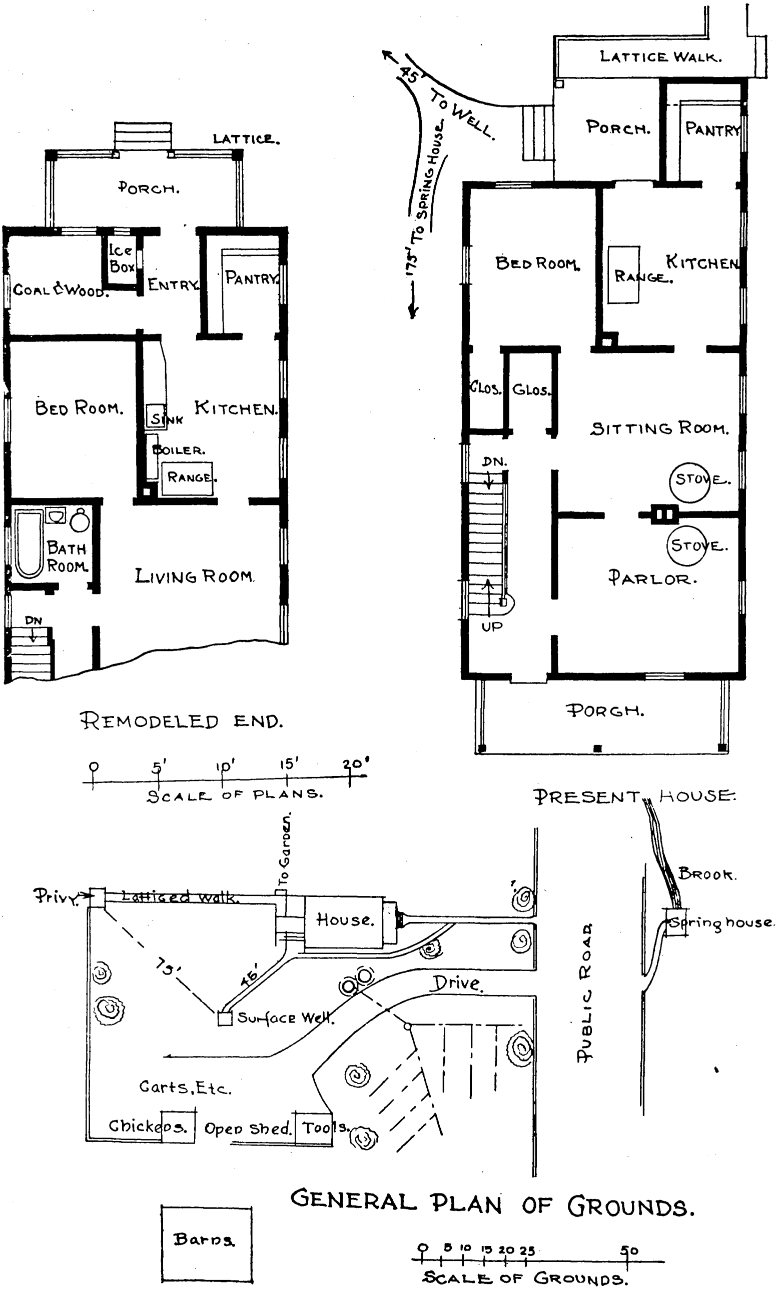


FIG. 23.—Present and improved plan for an eastern farm home.

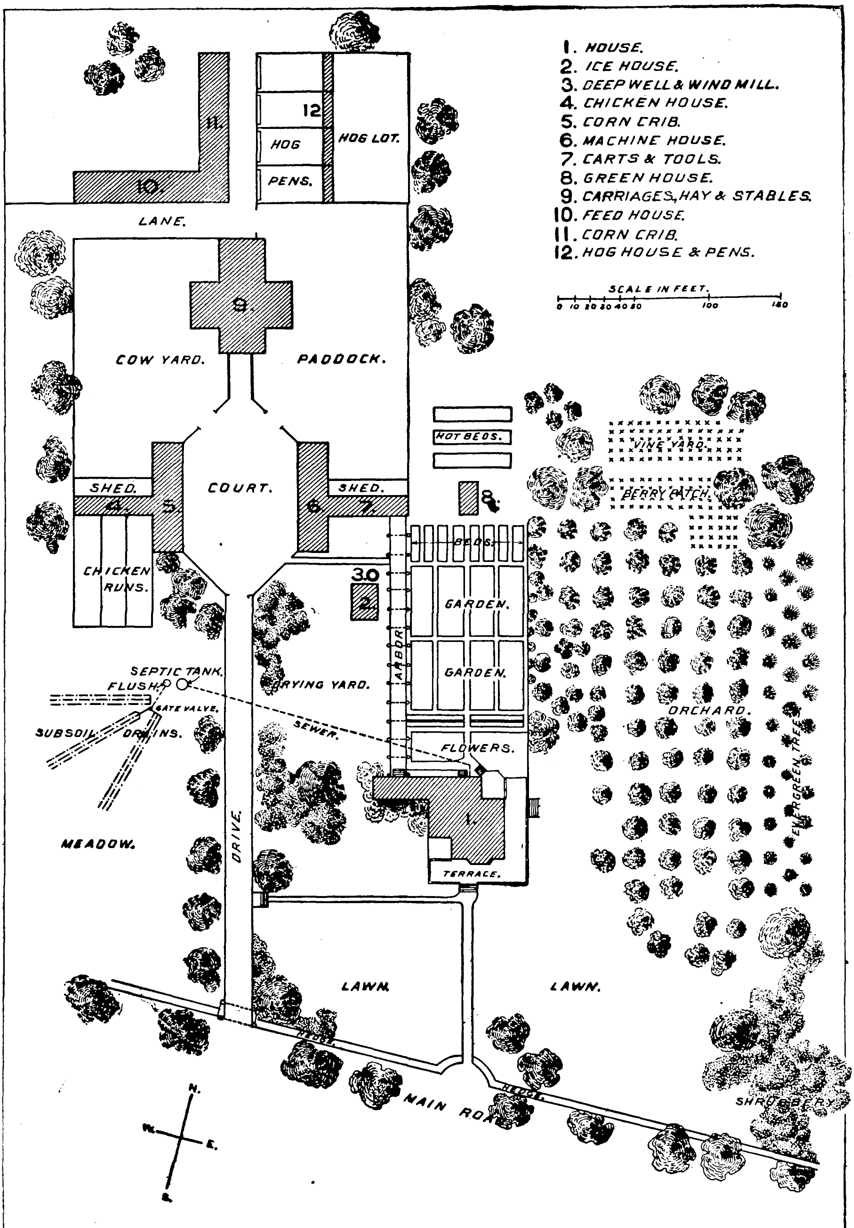
water is carried up the hill to the house, a distance of 150 feet. The plan of the house as given shows the conveniences that could be added with slight changes.

An elevated tank is a favorite method of getting water pressure in California, as it is not necessary to provide against freezing, and one could be used in this case with a windmill or engine to pump the water into it. Three hundred feet of galvanized iron pipe would carry the water to both house and barn. The changes to be made in the kitchen are very simple. The bedroom closet that extends into the kitchen could be taken out and a closet provided from one end of the storeroom. The storeroom is converted into a pantry. The wall of the present pantry is extended 4 feet, which changes it into a fine-sized bathroom. The sink and laundry tubs are placed along this wall, allowing all the fixtures to connect to one soil pipe. The surface disposal system could be used for the sewage, a single-chambered flush tank collecting the wastes and discharging them intermittently, by means of two sets of openings, over the steep side of the hill.

Figure 23 gives a general plan of the buildings on a farm in eastern New York with a plan of the house, drawn on large scale, and a plan for the introduction of water into the kitchen and the installation of a bathroom.

At present a spring across the road furnishes water to a milk cooler, and a spring higher up the hill would furnish an adequate gravity water supply for the house. The piping of this water to the kitchen has often been talked of, but has never been done. As the kitchen wing is only one story high an attic tank could be put in over the kitchen and the water piped from this spring to the tank by $\frac{3}{4}$-inch galvanized-iron pipe. The overflow from the tank could be carried to a stock tank in the barnyard. A hot-water boiler could be connected to a water back in the kitchen range and hot water be furnished the kitchen sink, the bath tub, and the lavatory. A bathroom could be made by removing the partition between the two closets and putting a window in the outside wall. The waste pipe from the kitchen sink could be connected to the soil pipe in the bathroom. The disposal of the sewage could be obtained by the use of the subsurface irrigation system, the draintile being laid in the grass lot across the drive, as shown by the broken lines on the general plan. The floor of the back porch could be extended and a woodhouse built here to furnish fuel for the kitchen range. A small furnace in the cellar would not require much more coal than the two heaters now used and would make the rooms more comfortable with less work.

The requirements of no two families are ever the same, but these suggestions of improvements are made with the hope that they may be a help in solving similar problems.



GENERAL PLAN FOR FARM HOUSE GROUNDS.

FIG. 24.—General plan for farmhouse grounds.

ADVANTAGES OF BUILDING FIRST ON PAPER.

With the development of good roads, the telephone, and daily free mail delivery, the farmer is becoming less isolated and desires to install the improvements of his neighbors of both country and city. The most practical way of doing this is to lay the buildings out on paper, making provision for future extension wherever possible. A general plan of this kind is shown in figure 24. The orchard, the flower and vegetable garden, the vines and vineyard are all allotted spaces altho only a few trees and plants are started now.[a] The buildings for the machinery and the granaries can be located so as to shut off the barn-

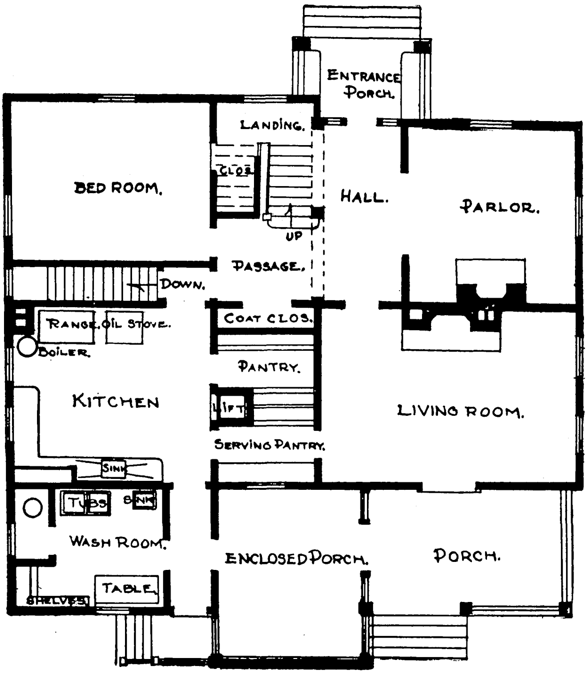


FIG. 25.—Plan for farmhouse.

yards from the house, with space left for additions when more room is needed. It is not economy to poorly house any kind of machinery. In building the house two rooms may be all that are to be built now, but if a plan is made that will provide for future additions a more convenient home will finally be secured at less expense that when a room is added wherever it seems best at present without regard to the finished house. A plan that contains some of the essentials of a comfortable home is given in figure 25. The living room, which is the dining room, overlooks the garden and is connected with an inclosed porch which can be used for a summer dining room, the passage from the

[a] See also U. S. Dept. Agr., Farmers' Bul. 185.

kitchen being arranged for this. The fireplaces are the best ventilators the rooms can have as well as affording a cheerful means of warming the room in spring and autumn before the furnace fire is started. The lift carries the prepared food, that should be kept cool, to the cellar without the need of going up and down stairs. If a pneumatic tank is used in the cellar the air near it is cool in the summer and advantage can be taken of this as a substitute for a refrigerator. The kitchen sink is against the laundry partition, while the bathroom would be on the second floor and over the laundry to keep all the plumbing together. The laundry can be used for a washroom if desired, and the water-closet off of it is convenient from both outside and in.

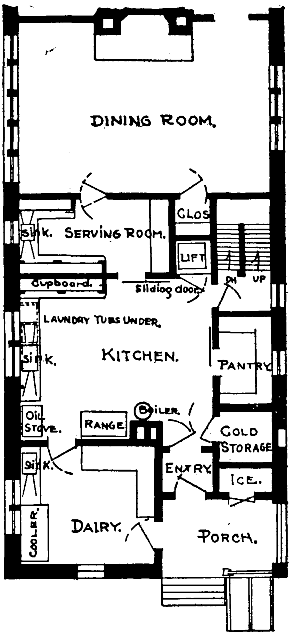


FIG. 26.—Plan for kitchen.

The planning of each room also pays. Figure 26 shows a kitchen and dairy, with accompanying conveniences. The ice box of the cold-storage room can be filled from the porch, and a winter door is provided, so ice need not be used in cold weather. The kitchen sink is supplied with hot and cold water, and altho the kitchen must also be used as a laundry, the stationary tubs are provided with a cover and serve as a table when not otherwise used. A lift brings the fuel from the cellar, and is used to take vegetables and fruit to and from the storeroom. Provision is made for washing the dishes in the pantry convenient to the shelves upon which they are kept, and plenty of shelf room is provided wherever it is needed.

The arrangement being first made on paper and lived in by the imagination many improvements will suggest themselves, until a home adapted to the use for which it is built will be the result when the plan is embodied by the carpenter and mason. The man that can make two blades of grass grow where one grew before has done something; but the man who makes one step do what took two before should also be given due credit.

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